Visual adaptation

An Infographic poster for research paper

Manohar lal

MD16MDES11011

Guided by

NeelaKantan PK

A Thesis Submitted to

Indian Institute of Technology Hyderabad

In Partial Fulfilment of the Requirements for

The Degree of Master of Design

भारतीय प्रौद्योगिकी संस्थान हैदराबाद

Indian Institute of Technology Hyderabad

Department of Design

May, 2018

Declaration

I declare that this written submission represents my ideas in my own words, and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and can also evoke penal action from the sources that have thus not been properly cited, or from whom proper permission has not been taken when needed.

Manohar lal

MD16MDES11011

Approval Sheet

This thesis entitled Visual adaptation : Infographic poster for Eraser based strain and pressure sensor by Manohar lal is approved for the degree of Master of Design from IIT Hyderabad.

Remedios
on behalf of Pr. Neelakantan

NeelaKantan PK
(Guide)

Dr.Deepak John Mathew
Chairman

External

Supervisor's Certificate

This is to certify that the work entitled "**Visual adaptation : Infographic poster for Eraser based strain and pressure sensor**" is a bonafide of thesis work by **Manohar la**l under my supervision for his M.Design degree.

on behalf of B. Neelakantan

Neelakantan PK

Assistant Professor
Department of Design
IIT Hyderabad

Acknowledgements

I would like to express my special thanks of gratitude to my Professor Dr.Deepak John Mathew, Dr.Prasad Onkar, NeelaKantan PK, Delwyn Remedios who gave me the golden opportunity to do this wonderful project on the topic (Visual adaptation : Infographic poster for Eraser based strain and pressure sensor), which also helped me in doing a lot of Research and i came to know about so many new things I am really thankful to them. Secondly i would also like to thank my parents and friends who helped me a lot in finalising this project within the limited time frame.

Dedicated to

My Family,
Friends,Guide,Teachers
and
all my well wishers

Abstract

A visual representation is worth than a thousand words and when the subject is combination of design and technical engineering this seems more worthy and relatable. Both designers and researcher do their study and research and then document in something which is more accessible.
This thesis addresses the concept of learning through visuals, a method which helps students and people in better understanding of subject and lead them towards more critical thinking.

It is a collaborative project between me and the student of electrical engineering department in IIT Hyderabad. In which objective was to understand research papers and narrow it down in the form of infographic poster and visual narration.

This published paper belongs to Electrical Department and, the topic is “Eraser based eco-friendly pressure and strain sensor.” The main aim is to develop an infographic poster for the conference purpose where visuals will help the people to understand the research more effectively.

This is an attempt of bringing interest in the subject through narration and visual representations of the research paper with proper infographics. As a designer my approach was to understand the content from published paper and tried to design it in a way to make it more understandable. This thesis is my journey of learning a totally new subject, understanding the concepts, developing them into easy and clear visuals.

TABLE OF CONTENTS

Declaration

Approval Sheet

Acknowledgements

Abstract

CHAPTER 1. Research **1**

1.1 Statement of Problem 2

1.2 Process 4

1.3 Understanding the Importance of Visual in research papers............................ 6

1.4 Information about paper... 7

1.4.1 Understanding the Content.. 8

1.4.2 Word mapping.. 9

1.4.3 Some important terms in the paper... 10

CHAPTER 2. Visual Intervention **11**

2.1 Storyboard 12

2.2 Illustration process... 14

2.2.1 Doodles.. 15

2.3 Icon design process.. 16

2.3.1 Exploration... 17

2.3.2 Icon family... 18

2.4 Narrating research paper.. 20

2.5 Sketches.. 23

TABLE OF CONTENTS

CHAPTER 3. Design development and visual language

3.1 Design Guidelines for Development of Poster **29**

3.1.1 color.. 30

3.1.1.2 color scheme 30

3.1.2 Visual hierarchy 31

3.1.3 Typography 32

3.1.4 Layout 33

3.2 Evolution of visuals 34

3.3 Making of icons 35

3.3.1 Color Selection 38

3.3.2 Building icons 40

3.3.3 Set of icon 41

3.4 Dimension 42

3.5 Grid 43

CHAPTER 4. The Prototype Design and Evaluation 45

4.1 Wireframe of poster **47**

4.2 Execution... 48

4.2.1 Prototype for infographic poster 49

4.2.2 Prototype for visual narration of paper 50

CHAPTER 5. Conclusion 60

5.1 Conclusion 61

BIBLIOGRAPHY **62**

Chapter 1

Research

1.1 Statement of Problem

Poster is a primary communication tools in the conference. Poster gives a full tour to the research which has done. Most of the technical department posters have a lack of visuals and full of text which gather more concentration towards the text to understand the concept. So much of text in posters can make a person ignore some lines and make them find only important things in the poster.

Same with the research papers also, it contain a lot of text which makes a person to visualize the concept behind the paper. In this way people sometime misunderstand with the concept or sometime they take more time to understand.

It seems that infographics are more effective and flexible way of reading and understanding. while at the same time people have different experiences and expectations for using visuals.

Objective

The Aim is to make a poster for existing posters, research paper with infographics, and produce some fundamental guidelines for structure, organization, and design layout and grid system of technical infographics research papers. The evaluation and design guidelines will be developed using principles from design, elements of design. The study will create a prototype design as an example of infographics narration of research papers and conference posters as well.

The project aims at bridging these gaps by bringing interest in the subject by narration and visual representation of the concepts with proper scalable example which will leaves the people and student with curiosity of all the possible things that can be explored and achieved in this domain.

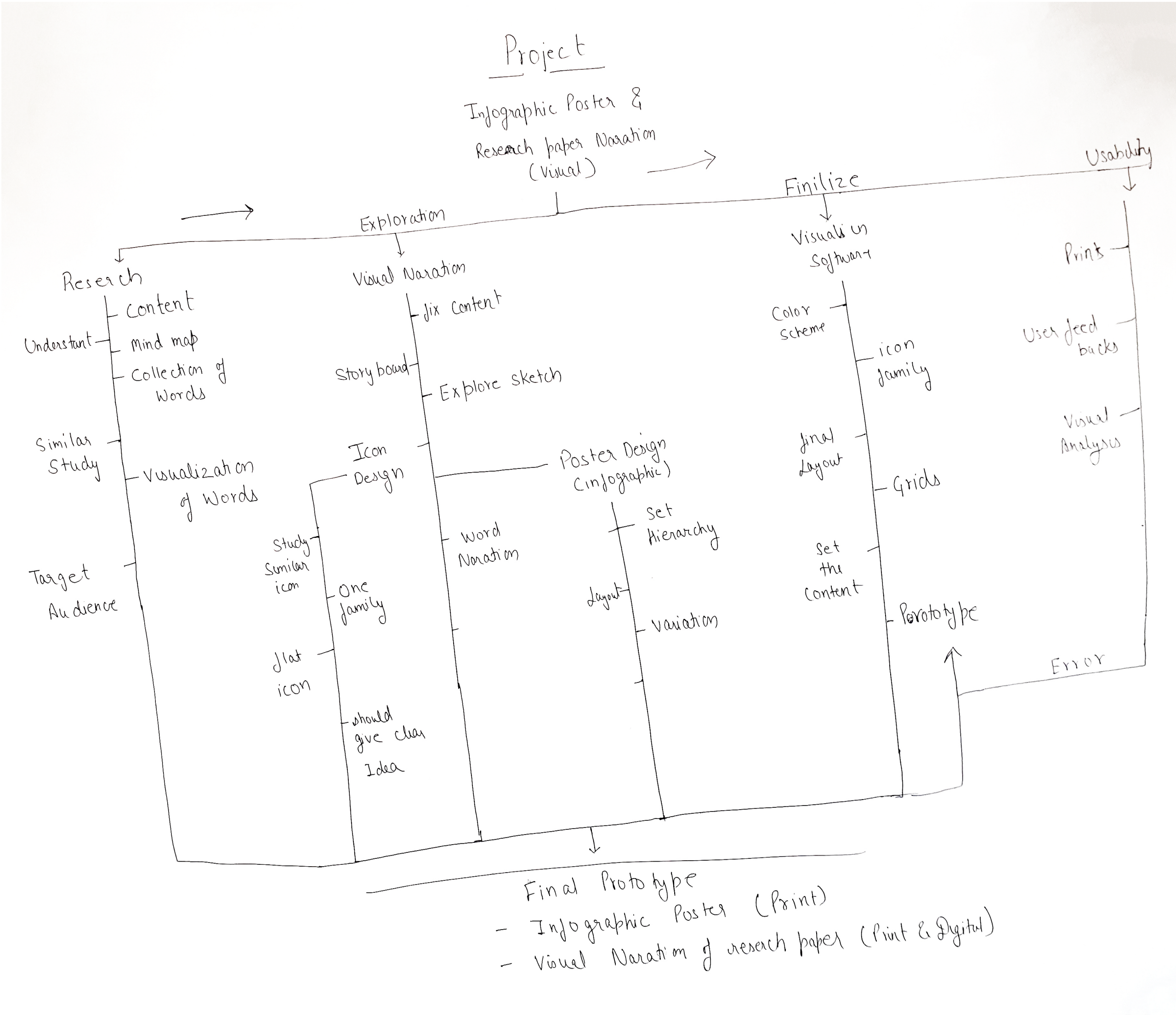
Scope

During this project I hope to understand about technical term behind the research paper of Electrical Department, they have published a wonder full research on 'Eraser based eco-friendly pressure and strain sensor'. I wish to simplify those complex terms and to developed an easy and simple illustration and try to develop proper infographic narration and a poster of the research paper by bringing the visuals into the pictures.

1.2 Process

- Process will include collection of data (content and images).
- Understanding the content.
- Analysis content and looking up for suitable images.
- Studying the similar work
- Understanding the same department PHD students interaction with the published papers.
- Exploring images , illustrations and Icons.
- Narrowing down the content and finalizing.
- Design Development/ style decision making.
- Execution of design
- Users feedbacks (interview and analysis).
- Final prototype

1.2.1 Process breakdown



1.3 Understanding the Importance of Visual in research papers.

Visual representations (i.e., photographs, diagrams, tables, charts, models) have been used science over the years to enable scientists, students to interact with complex phenomena (Richards 2003) and might convey important evidence not observable in other ways. Visual representations in science may refer to objects that are believed to have some kind of material or physical existence but equally might refer to purely mental, conceptual, and abstract constructs (Pauwels 2006). Science is not only about replicating reality but also about making it more understandable to people (either to the public or other students), visual representations are not only about reproducing the nature but also about:

(a) functioning in helping to solve a problem,

(b) filling gaps in our knowledge, and

(c) facilitating knowledge building or transfer (Lynch 2006).

Visual understanding utilize graphical ways of working with ideas and presenting information. Much research including educational theory tells us that visual understanding is among the very best methods to get through someones concepts.

Visuals can easily understand and retains information when words, concepts and idea are addressed with images. Some common visual understanding strategies include creating graphic organizers, diagramming, mind mapping, outlining and more.

1.4 Information about paper

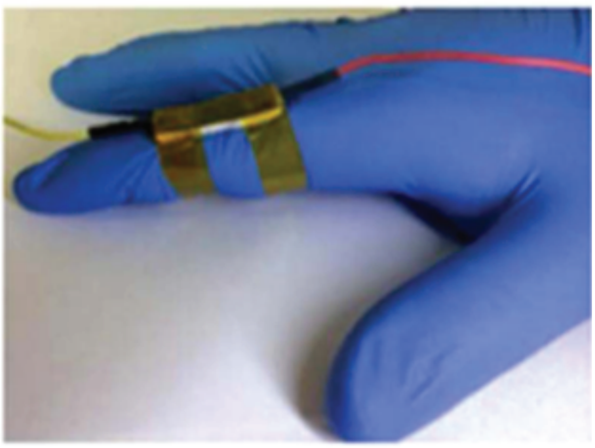
This paper reports a new type of electronic, recoverable skin-like pressure and strain sensor, produced on a flexible, biodegradable pencil-eraser substrate and fabricated using a solvent-free, low-cost and energy efficient process. MWCNT film, the strain sensing element, was patterned on pencil eraser with a rolling pin and a pre-compaction mechanical press.

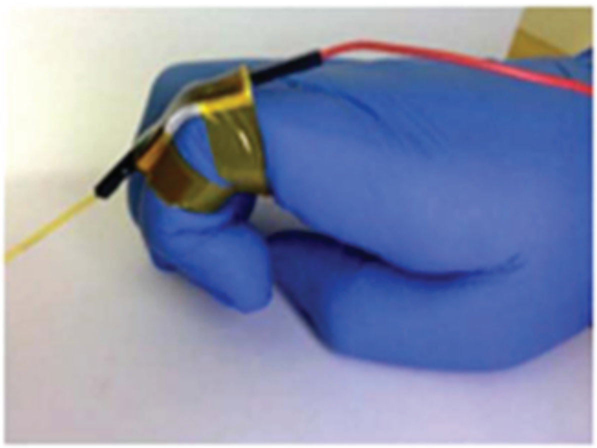
Eraser-based eco-friendly fabrication of a skin-like large-area matrix of flexible carbon nanotube strain & pressure sensors

This induces high interfacial bonding between the MWCNTs and the eraser substrate, which enables the sensor to achieve recoverability under ambient conditions.

The eraser serves as a substrate for strain sensing, as well as acting as a dielectric for capacitive pressure sensing, thereby eliminating the dielectric deposition step, which is crucial in capacitive-based pressure sensors. The strain sensing transduction mechanism is attributed to the tunneling effect, caused by the elastic behavior of the MWCNTs and the strong mechanical interlock between MWCNTs and the eraser substrate, which restricts slippage of MWCNTs on the eraser thereby minimizing hysteresis.

The gauge factor of the strain sensor was calculated to be 2.4, which is comparable to and even better than most of the strain and pressure sensors fabricated with more complex designs and architectures. The sensitivity of the capacitive pressure sensor was found to be 0.135 MPa^{-1}.





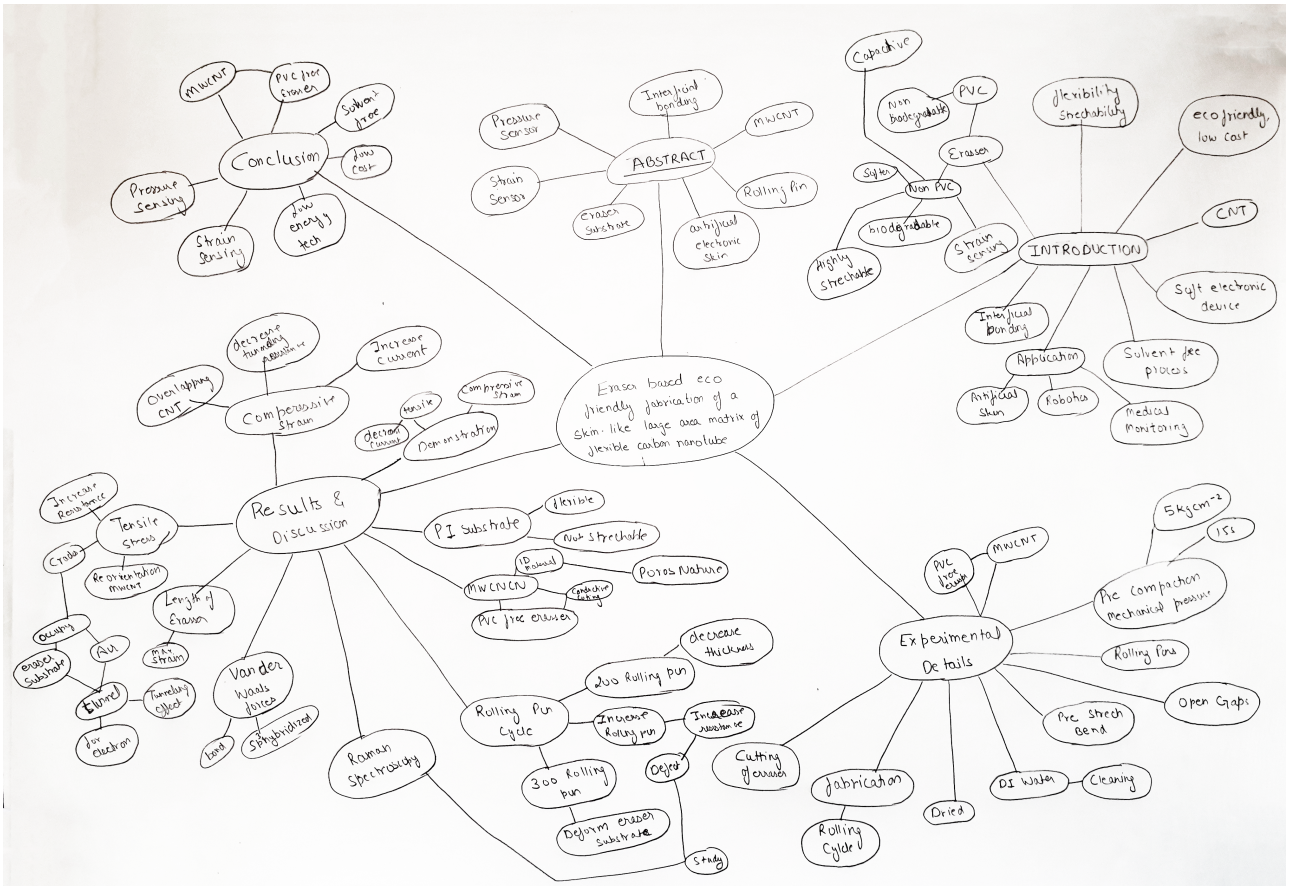
1.4.1 Understanding the Content

“This is a published paper which is based on Nanotechnology, published on 30 January 2017 by Parikshit Sahatiya and Sushmee Badhulika, Department of Electrical Engineering, Indian Institute of Technology Hyderabad.”

The initial step of the project which makes me to go through the research papers. The content in the research paper is very new to me and very technical, to understand that I had a several meeting with my mentor (engineering), where they share their thoughts, explained to me theories, terms, concepts. I searched some terms in internet for more understanding. Even I was taking helps of visuals in internet to understand the technical terms.

I was more immersing myself into the content of paper. What I did, I used to go to lab and try to involve with them when they were testing the product and try to understand the experiment they were performing. I kept sketching alongside and started collecting relevant images for reference.

After getting to know about the content I start visualizing them in my way. I did search for the similar kind work done in this field in order to get more inspiration. I also took a survey to understand more that what kind of visuals will be easy to understand by the engineering background students.



1.4.2 Word-mapping

Abstract

MWCNT
Rolling Pin
Artificial E-Skin
Eraser Substrate
Strain and pressure sensor

Result & Discussion

- PI Substrate
    - Flexible
    - Non streachable
- MWCNT
    - Poros nature
    - Conductive coating
    - PVC free eraser
    - 1 Dimensional material
- Rolling pin cycle
    - 300 rolling pin cycle
        - Deform eraser substrate
    - Increase rolling pin
        - Defect
            - Raman Spectroscopy
- Van-der Wall forces
    - Bond
    - Sp3 hybridisation
- Tensile stress
    - Increase resistance
    - Re orientation MWCNT
    - Cracks
- Compressive strain
    - Increase current
    - Overlapping CNT

Introduction

- Interficial bonding
- Flexibility, Streachability
- Eraser
    - PVC eraser
        - Non-Biodegradable
    - Non PVC erasser
        - Biodegradable
        - Capacitive
        - Highly Streachable
        - Softer
        - Strain Sensing
- Eco- friendly, low cost
- CNT
- Soft electronic device
- Solvent free process
- Application
    - Artificial skin
    - Robotic
    - Medical monitoring

Experimental details

- Pre compaction mechanical pressure
- Rolling Pin
- Open gaps
- Pre streach bend
- DI water
    - Cleaning
- Dried
- Fabrication
    - Rolling pin
- Cutting of erasser

1.4.3 Some Important terms in the paper

MWCNT

Multi-walled carbon nanotube, Conceptually, a SWCNT is a one-atom-thick layer of graphite, called graphene, wrapped into a seamless cylinder with either open or closed ends. As their name implies, MWCNTs consist of multiple concentric layers of graphene that form a tube shape.

PVC free erasser

PVC free eraser is used in this experiment which is very low cost, biodegradable and softer than PVC eraser.

Interfacial Bonding

It refer to a term of strong mechanical interlock between MWCNTs and the eraser substrate.

Capacitive

In electrical engineering, capacitive sensing (sometimes capacitance sensing) is a technology, based on capacitive coupling, that can detect and measure anything that is conductive or has a dielectric different from air.

DI water (Deionized Water)

Ions are electrically charged atoms or molecules found in water that have either a net negative or positive charge. For many applications that use water as a rinse or ingredient, these ions are considered impurities and must be removed from the water.

Solvent free

A substance made using little or no solvent is known as solvent-free. It is eco-friendly and used in many industries to reduce corrosion and environmental pollution.

Fabrication

It is refer as the action or process of manufacturing or inventing something. Here MWCNT with the help of rolling pins making a film surface to fabricating the eraser.

Rolling pins

It is a process where rolling pin cycle performs to make MWCNT film on eraser substrate.

Biodegradable

It is define as substance or object capable of being decomposed by bacteria or other living organisms and thereby avoiding pollution.

Rolling pins

It is a process where rolling pin cycle performs to make MWCNT film on eraser substrate.

Eco- friendly

Eco-friendly literally means earth-friendly or not harmful to the environment.This term most commonly refers to this products that contribute to green living or practices that help conserve resources like water and energy. This is Eco-friendly products, it also prevent contributions to air, water and land pollution.

Hybridization

Mixing atomic orbitals into new hybrid orbitals (with different energies, shapes, etc., than the component atomic orbitals) suitable for the pairing of electrons to form chemical bonds in valence bond theory.

Chapter 2

2 Visual Intervention

Here I started generating visuals on the bases of understanding the concept, images and diagrams. I started playing with the forms in the way of exploring drawings with a tdifferent style and methods

Brainstorming, storyboarding, discussion helped me a lot in making illustrations and icons. Principle of design and elements of design helps me to create the strategy of the visual aesthetic that works to compliment the technical terms.

2.1 Storyboarding

Absract	Pressure and strain sensor. Flexibility	MWCNT and it bonding with eraser.	Tunneling effect by MWCNT	Sensitivity and demonstrattion, E-skin.
Introduction	Conventional electronic device fabricated on rigid crystalline	Nature of device.	PU Sponge	Nature of eraser is used.
	PVC free eraser and property	Rubber and CNT.	MWCNT bonding with eraser substrate	Application Acid victim Burnt skin and the device
Experiment	Pre compaction mechanical pressure and rolling pin	Cleaning eraser with de-ionized (DI) water.	Dried at 70 °C for 20 min	MWCNTs were then applied on the eraser
	Remove the unattached MWCNTs	Washed in DI water and Dried.	cutting of eraser into the desired lengths and widths.	Mechanical press with a pressure of 5 kg cm^{-2} for 15 s

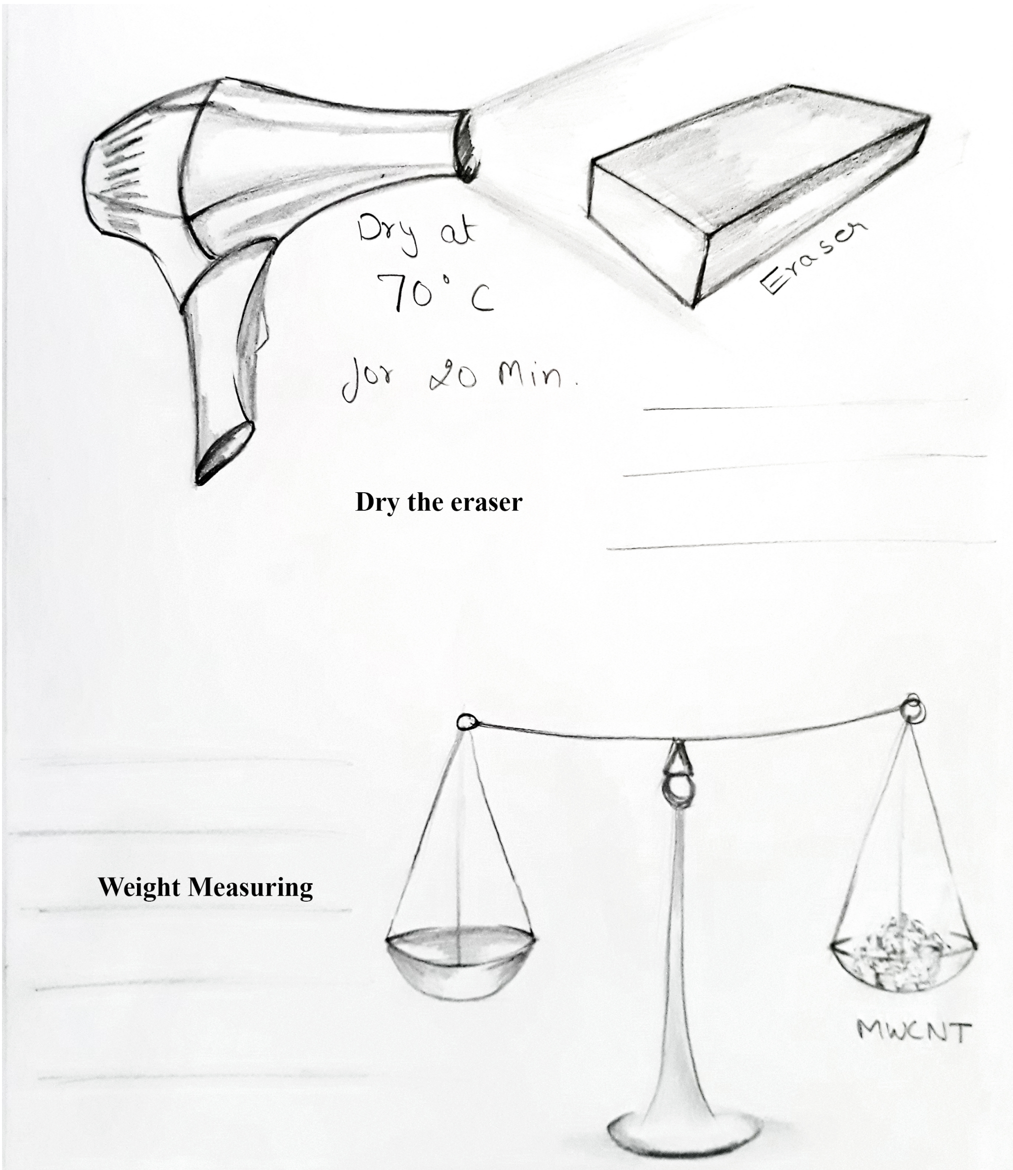
Results and discussion				
	Solvent-free fabrication process a using simple rolling pin	Use of PI as the substrate.	Variations in thickness and resistance with rolling pin cycles.	Rolling pin cycles above 300
	Use of Raman spectroscopy	Nature of the van der Waals forces.	Tensile strain and its effect.	compressive strain and its effects.

2.2 Illustration process

By the analysis of previous images of the concept and the data I got from the discussion, I started exploring the images in the form of illustration. I started visualizing the content in order to give shape and form.

Initial sketches are in the form of scribbles where I crossed checked with the co guide (engineering) that how relevant it is with the actual content.

These scribbles then redrawn on fine paper as a final image. After the final image has drawn, I begin applying details, shading. Sketching is quicker by hand and using photoshop to resize and move things around allows me to create several options quickly before deciding on the final composition.



2.2.1 Doodle

MWCNT
ERASER
Pre stretch
bend
DI
IPA
E
Act as Dielectric for Capacitive Strain sensing
MWCNT
Rolling Pin
Bio degradable
PVC Free Eraser
PVC Eraser
Moniter
pressure/ strain sensor
pressure sensitivity
Strain Sensor
Sensitivity 0.135 mPa
Dielectric for Capacitive pressure Sensing
Top View Eraser

2.3 Icon design process

Discovery stage

This is where I analyse the brief, define keywords for each icon and then try to find the perfect representation or a metaphor for those keywords. I looked my sketches and content that I analysed which is a direct association with the concepts.

Design Stage

Mood boards helps convey the thtought after look and feel, the visual style can then be decided upon, I choose to make a flat icon with the appropriate level of detail. Initially I started giving more excessive detail which is a distraction and again affect how easily recognised the icon is.

Implementation Stage

Here I tested my icons within the actual interface, I took feedback before heading back to the drawing board. This cycle is repeated until the final look is achieved. The saying, 'A painting is never finished, you just stop working on it' can be easily applied to the icons.

Buidding on existing icons

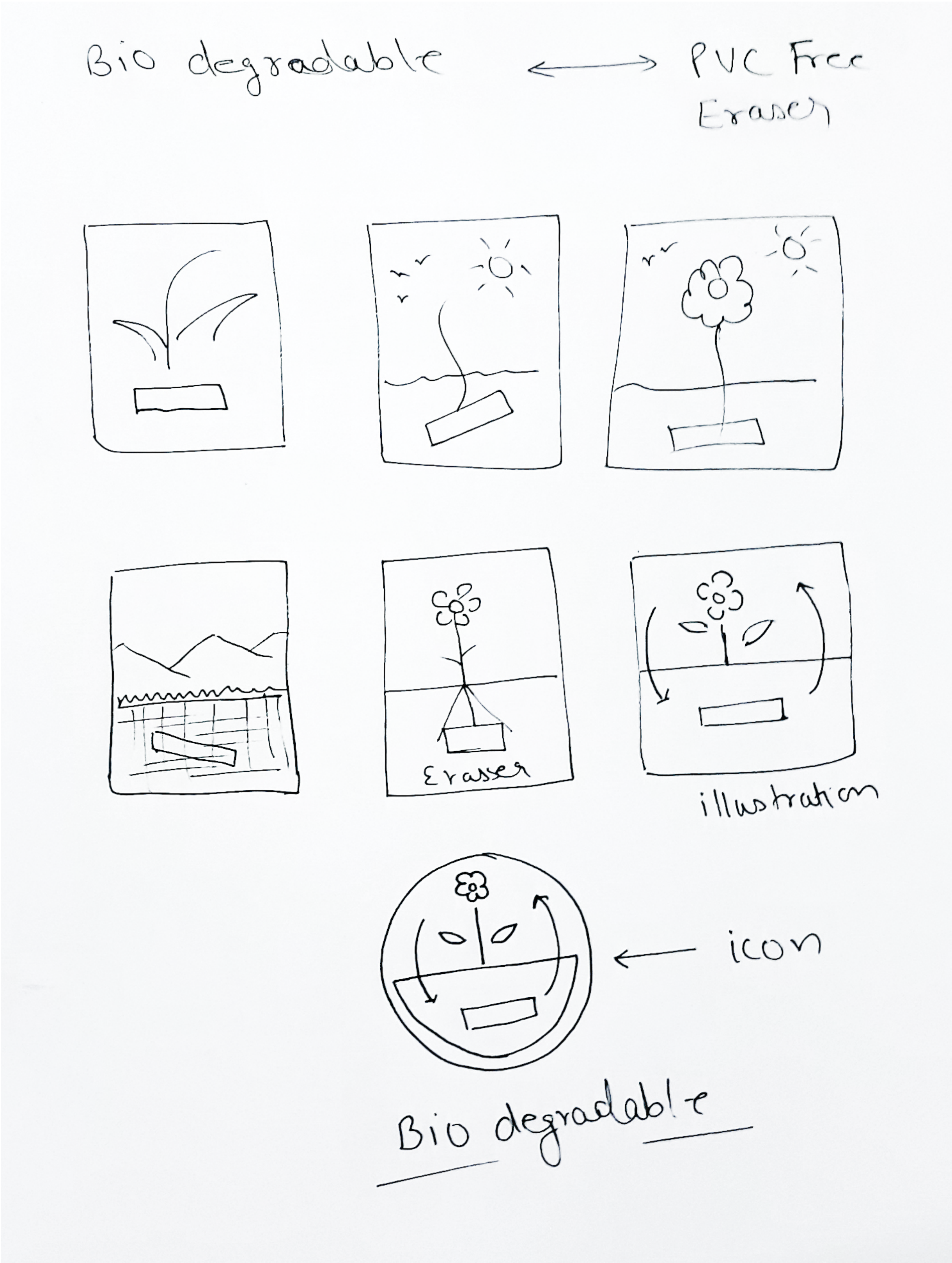
People understand more easily with their past experience of visuals. The existing icons can help viewers to easily get into the meaning of the icon. I have matde on the bases of existing icons.

Creating an icon family

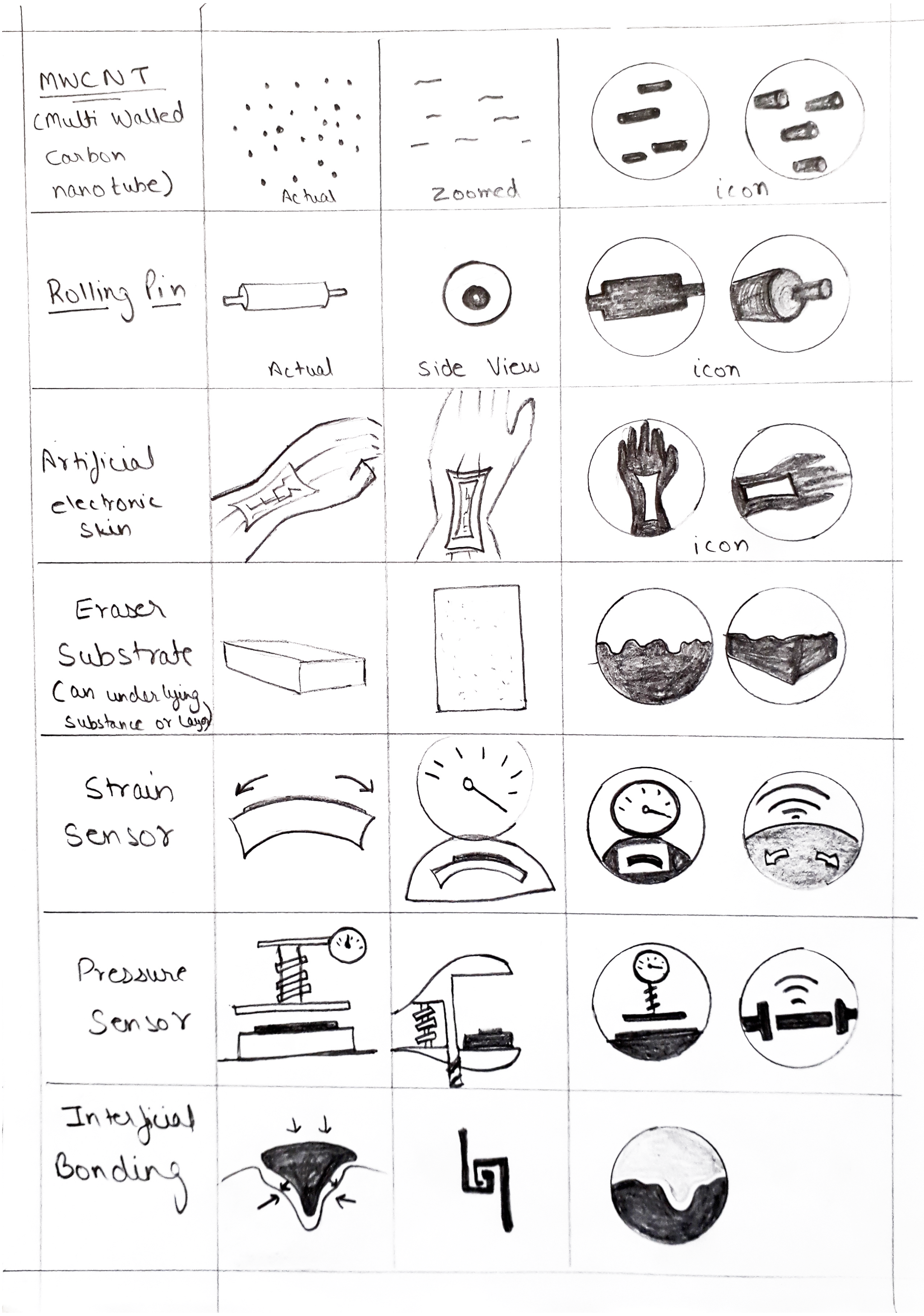
Instead of trying to design each icon as a separate entity, I tried to give a form to make it looks like one family. My final outcome of icons are consistent with details like outline thickness, corner radius, colours and so on.

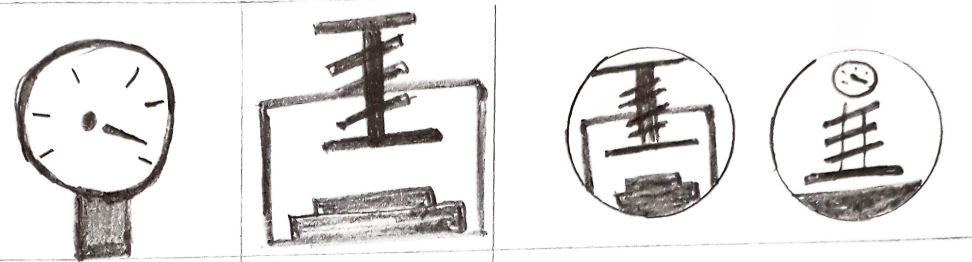
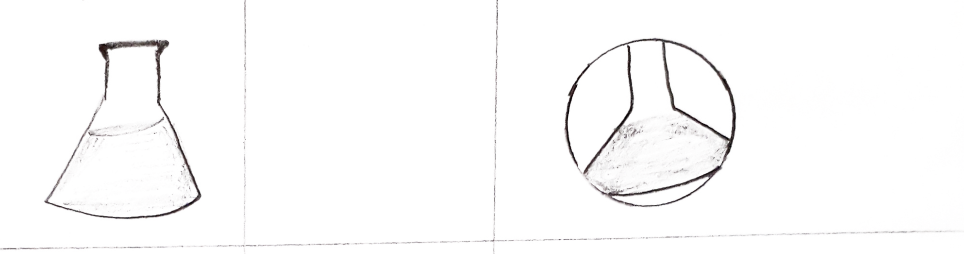
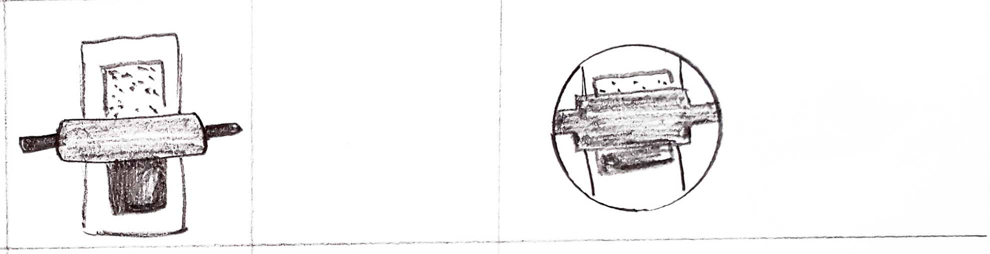
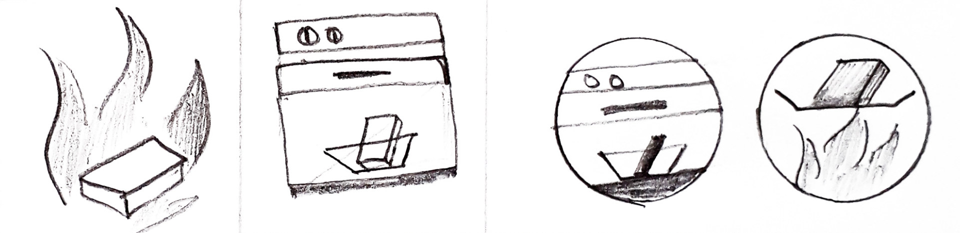
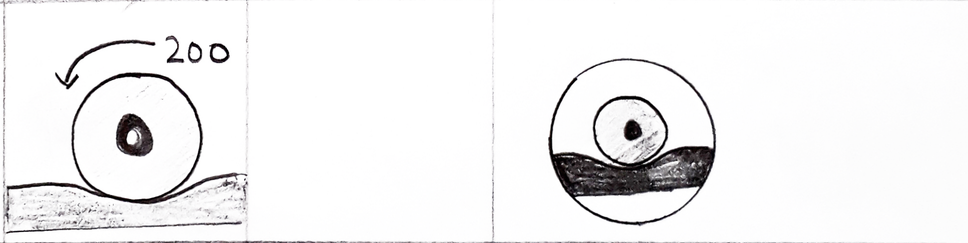
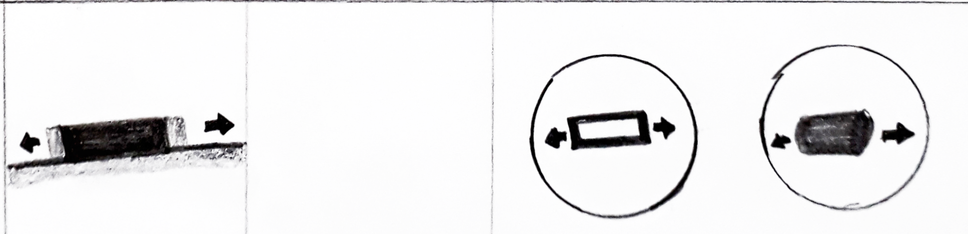
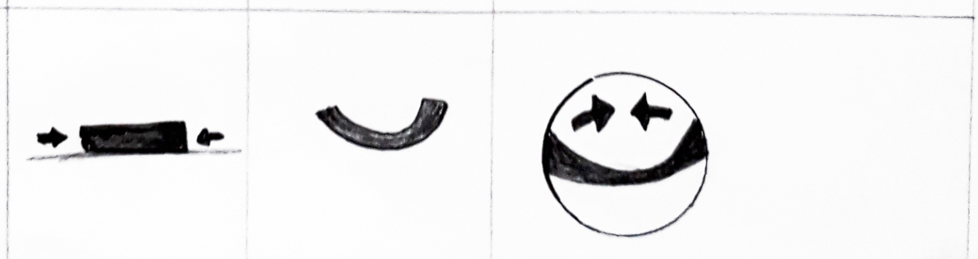
2.3.1 Explorations

One of the exploration I used



2.3.2 Icon family



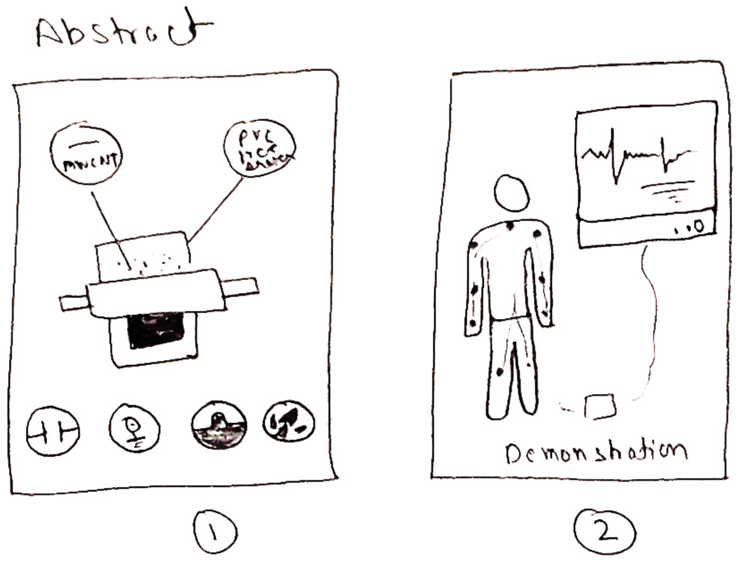
Pre Compaction Mech Pressure	
DI Water Distilled Water	
Fabrication	
Dried	
200 Rodling Pins	
Tensile Stress	
Compressive Stress	

2.4 Narrating research paper

After having much fail attempt I again made a new storyboard to narrate the research paper. I divided it in the bases of abstract, introduction, experiment, result and discussion and conclusion. I took each part lets say abstract which is further divided in the form of storyboard narration and started the process of sketching. I jot down the important terms narrow it down in the form of words or process name, then again I start giving form in such a way it look consistent with the previous once.

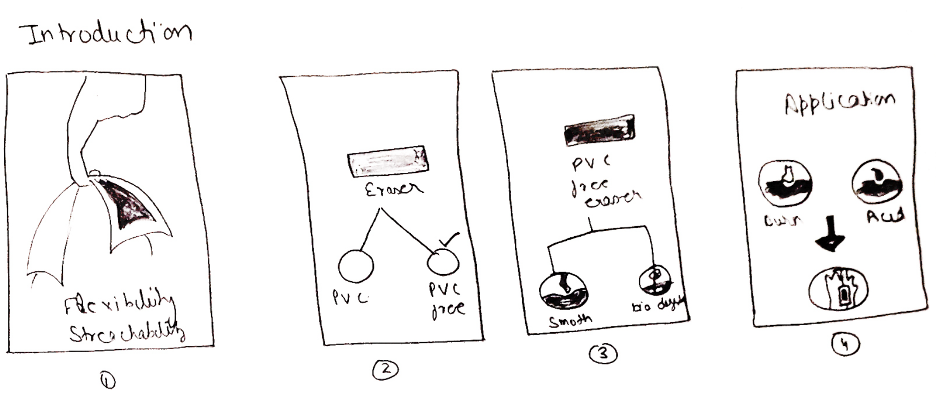
Abstract of paper

Instead of making every details of abstract it can be a breakdown into minimal, The subconscious brain is overloaded with information if it is too detailed, and their eyes search for important things mention in paper.



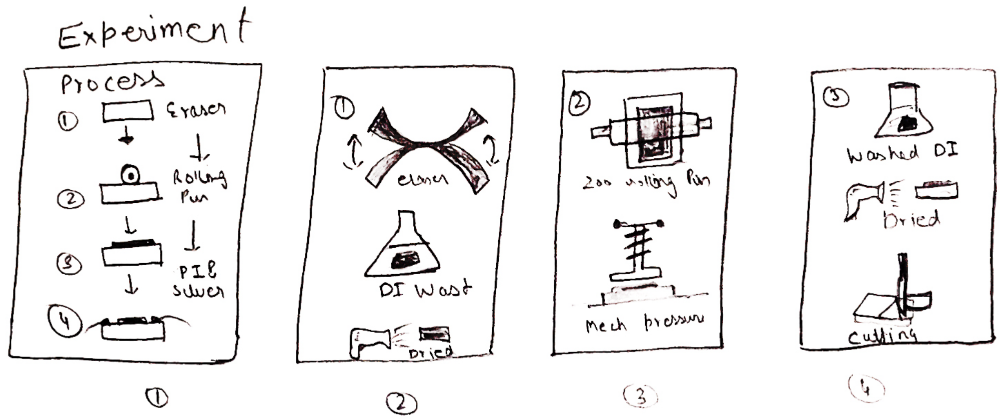
Introduction

Most of the technical papers have a long introduction which define each and every term they have used in the process, but sometime it become excessive too. Here I looked for the terms which have a very important role in whole research. That term was PVC free eraser, this eraser itself is the main product of device.



Experiment

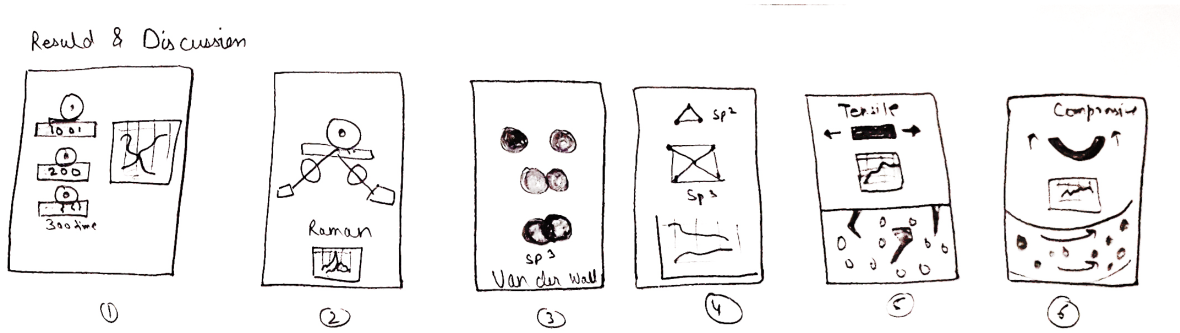
This is a section which is most viewed. Our target audience wants to know the process behind the product.



Result and discussion

Most of the technical terms are used in this section where they define the terms like Van Der Waal theorems, Raman Spectroscopy, Tensile and compressive strength, etc.

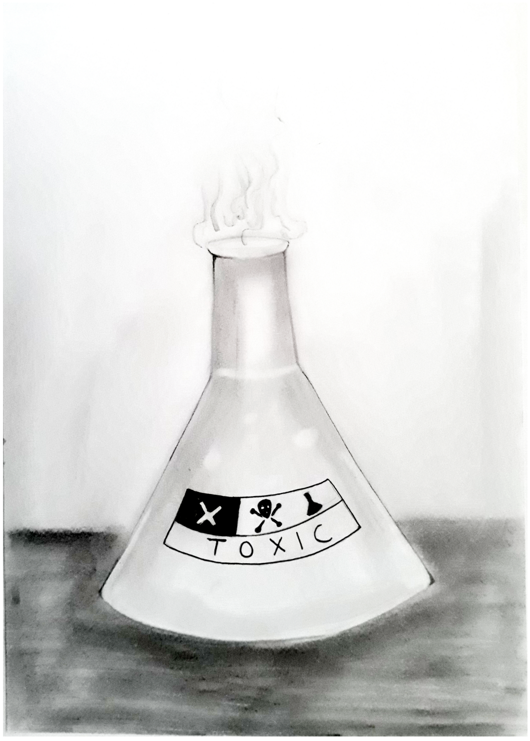
All the readings from experiment and graphs are used in this section. Narrow it down to visual is considered being challenging here. Very few and important terms I picked for visual narration and made icons for infographic poster.



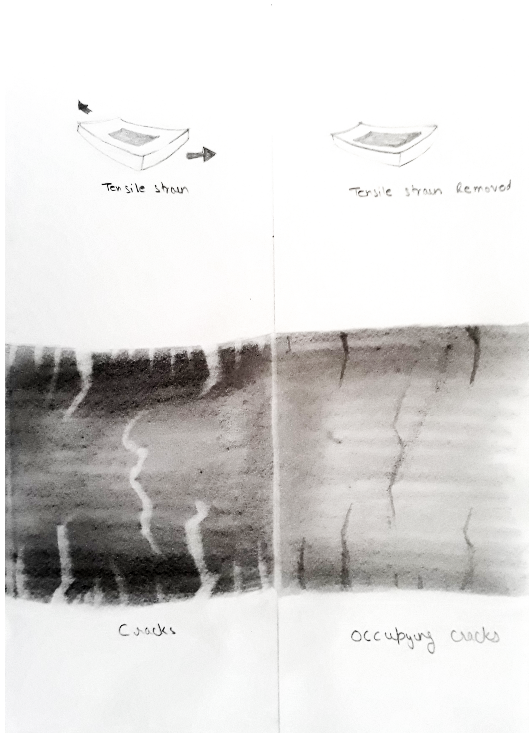
2.5 Sketches

After the making of a story board I started making rendered sketches for the visualization, which helps me to make a thing in software like illustration and icons. These sketches are for the reference for Visual narration and infographic poster.

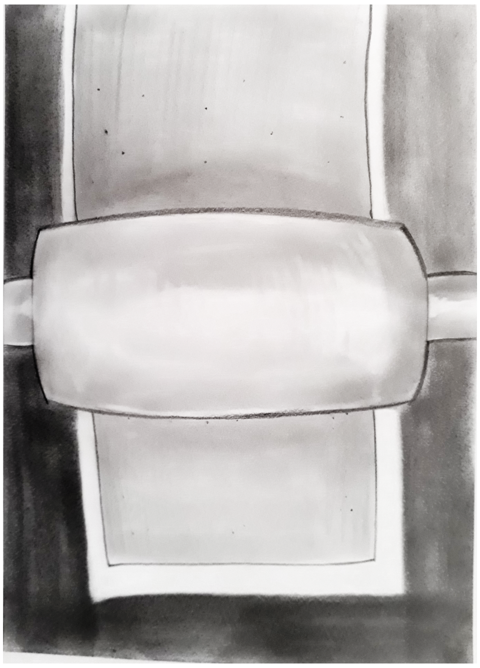
Some sketches are also narrating the process while some of them are just defining the one term.



Above sketch define the toxic nature of the substance.

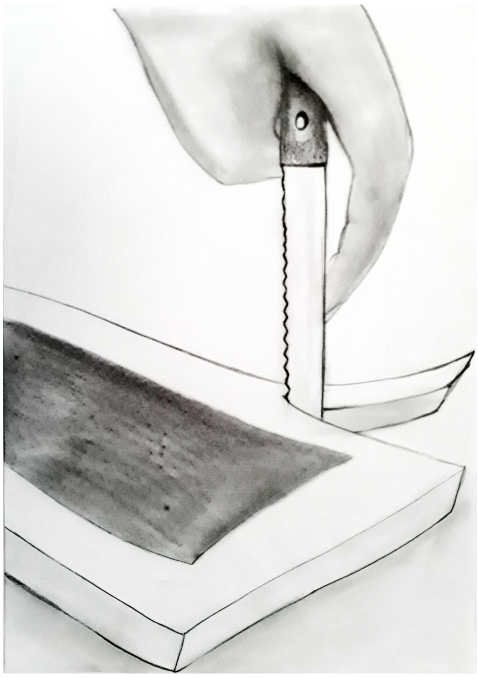


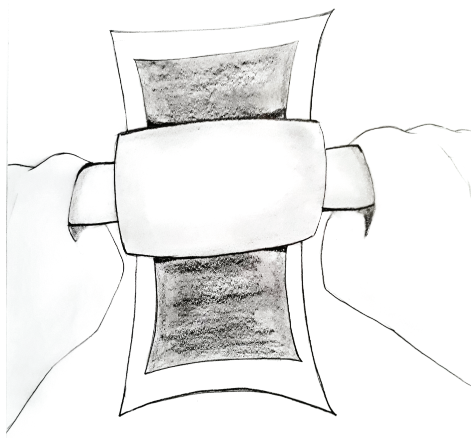
This sketch define the inner condition of eraser under tensile stress and when this stress is removed.



Rolling pin perform on eraser where it making MWCNT film

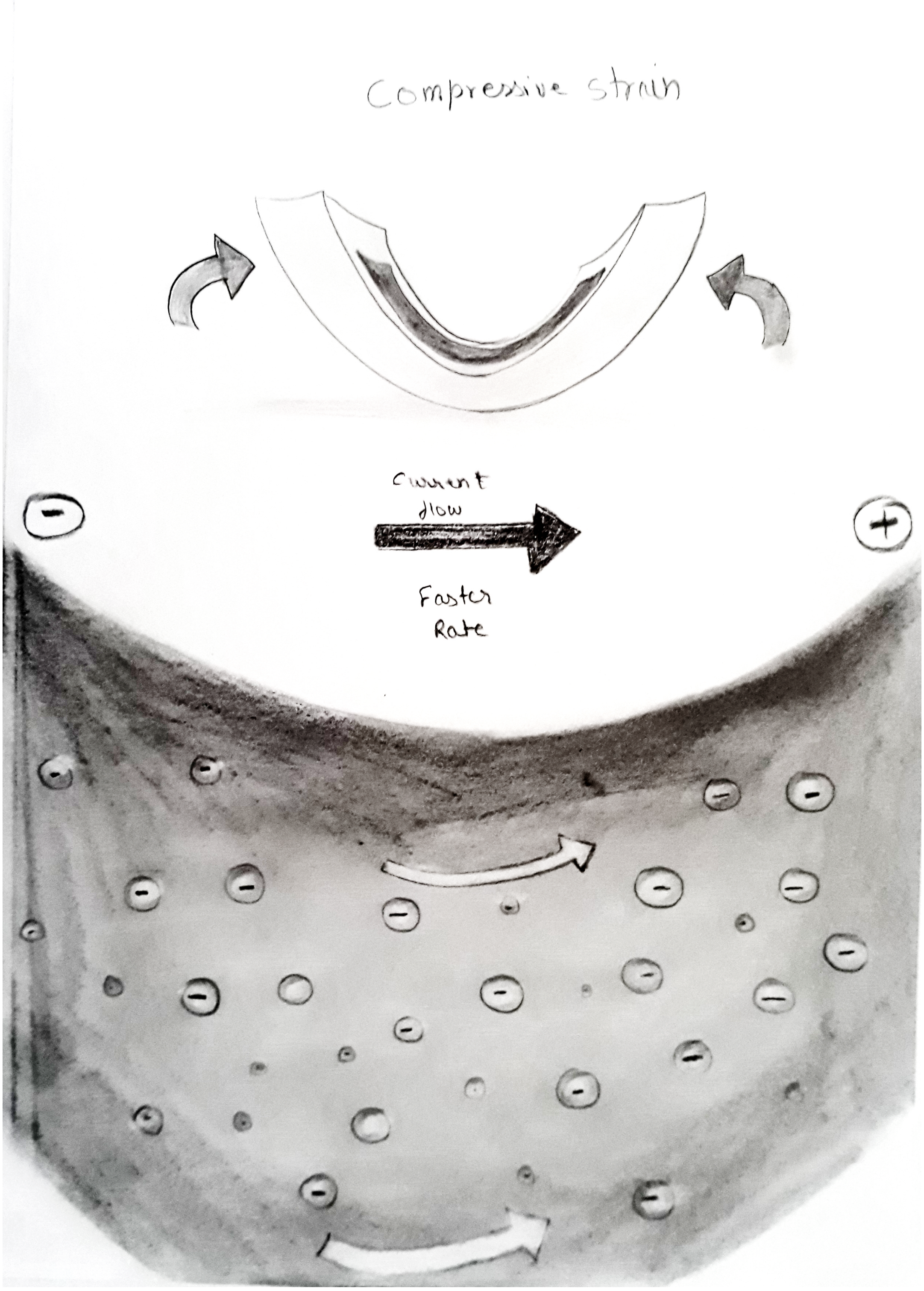
strong mechanical interlock between MWCNTs and the eraser substrate.



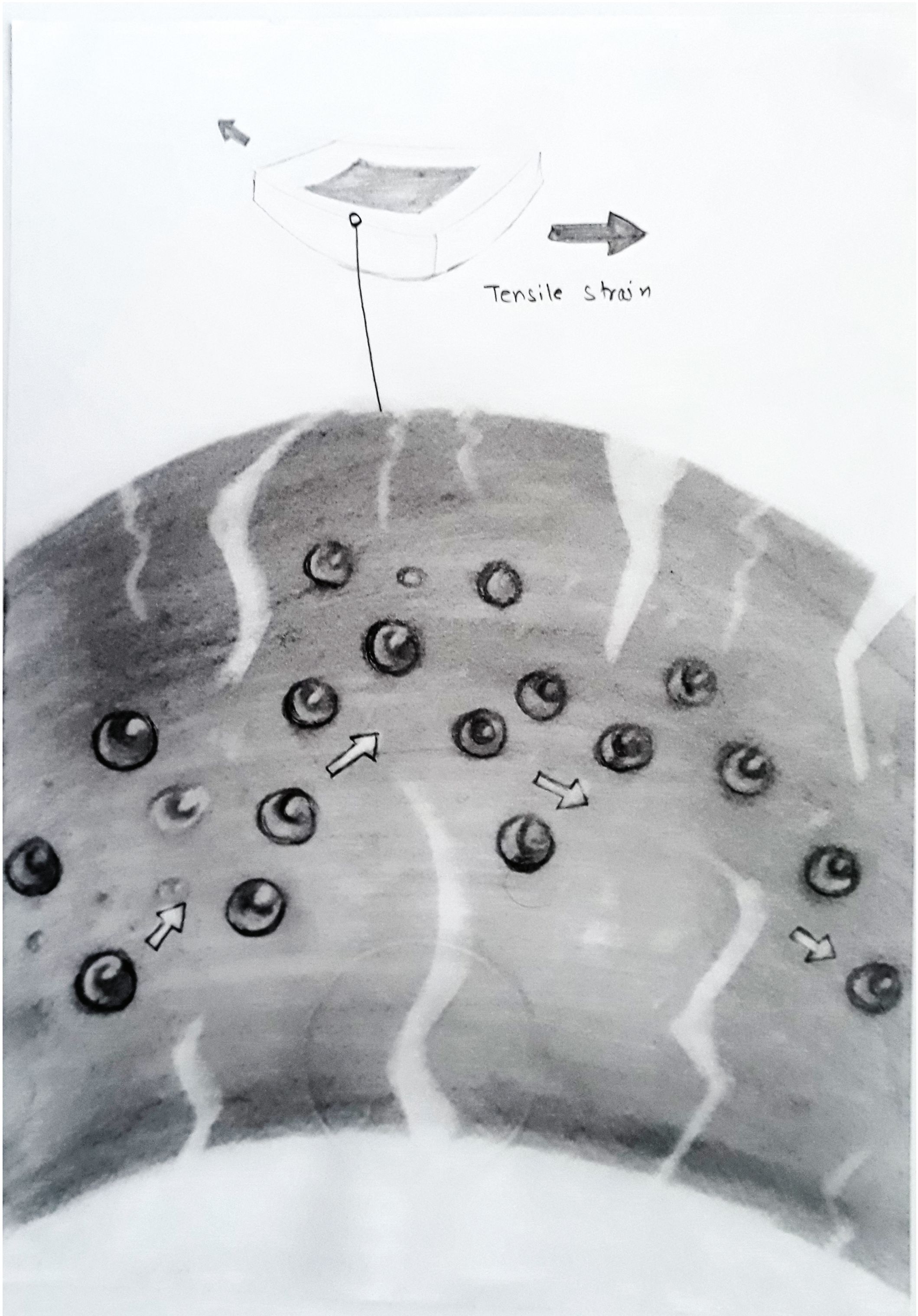


Cutting of eraser to its desired dimension

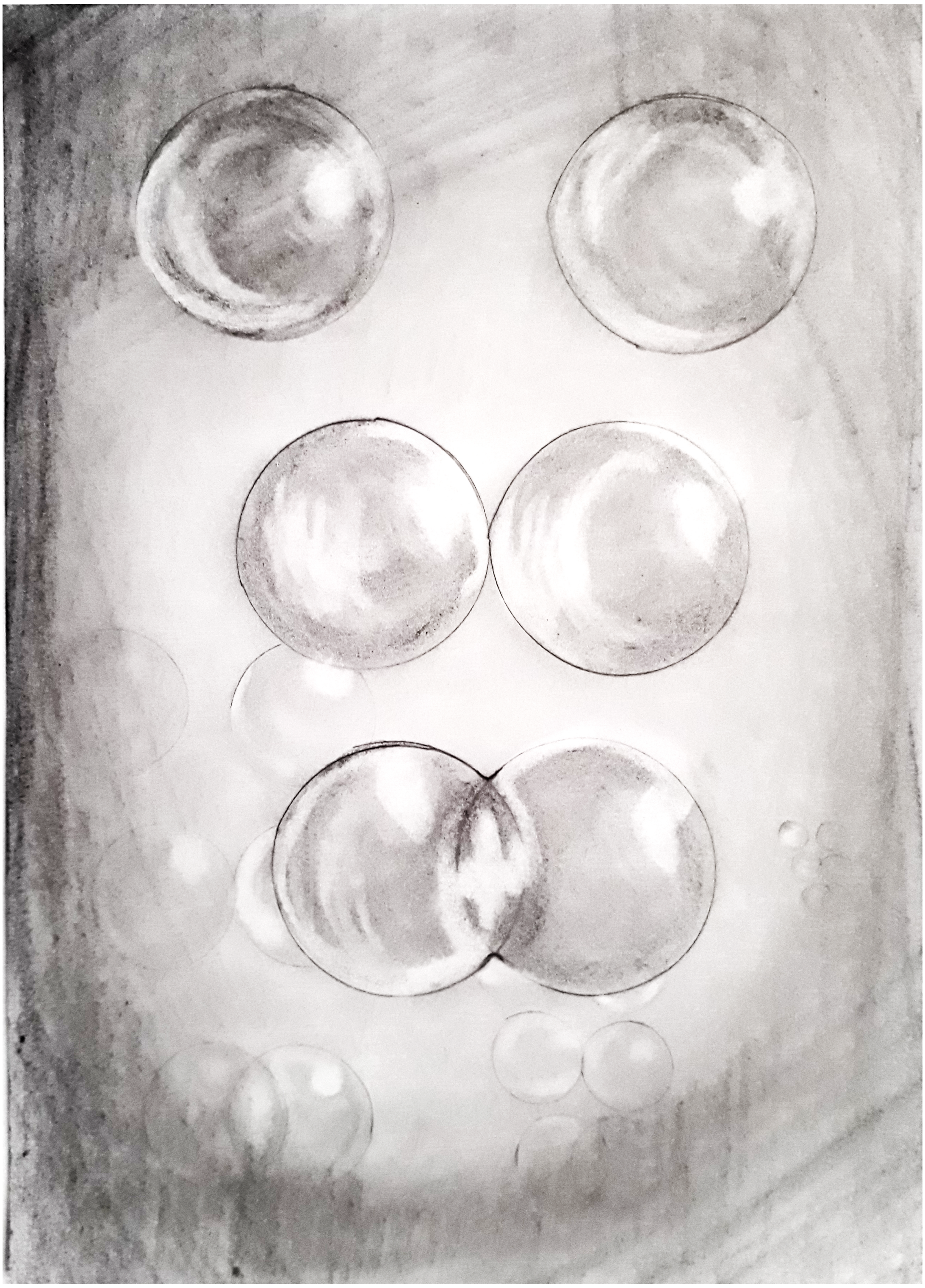
Another sketch of rolling pin on MWCNT



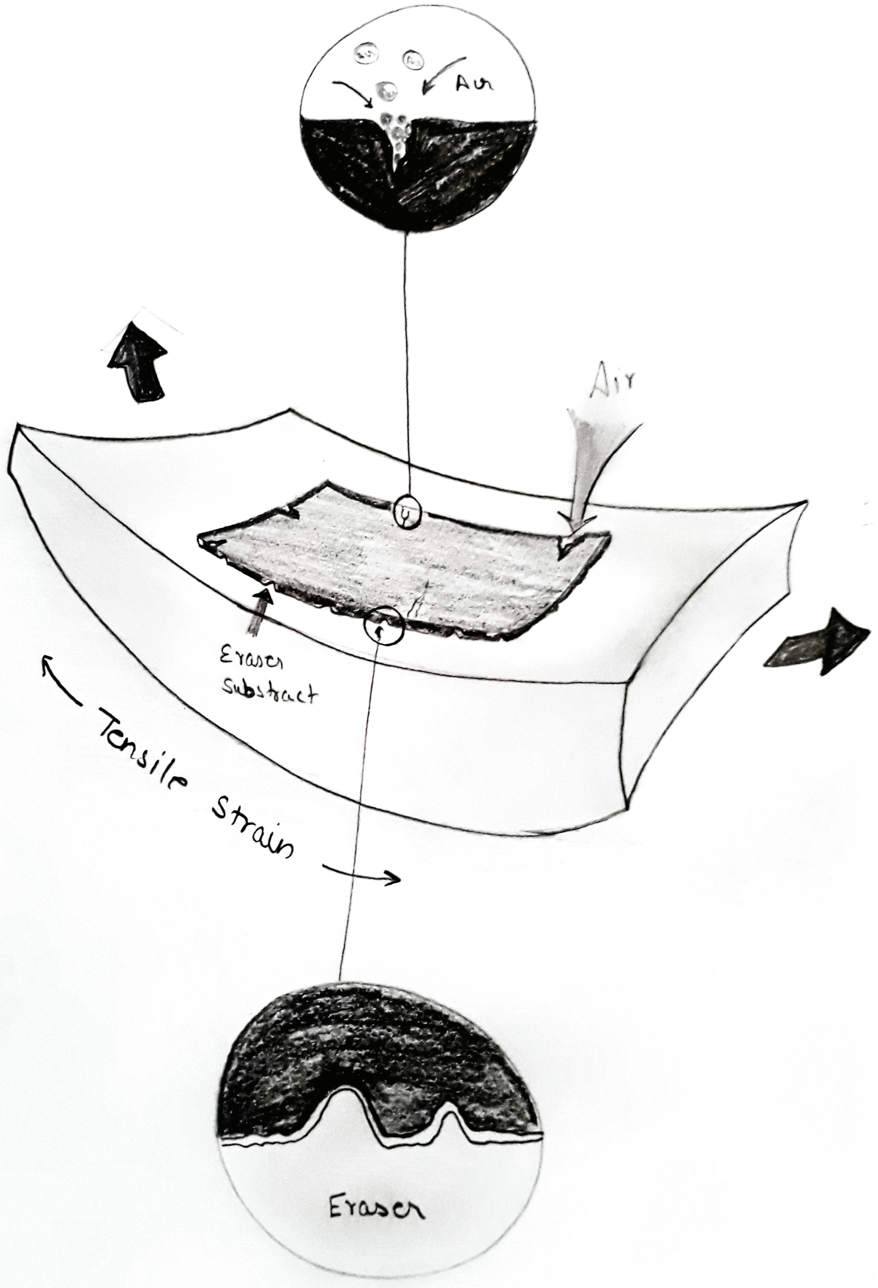
When eraser is under compressive stress and the inner view



When eraser is under tensile strain and the inner view



Van Der Waal theorem a detailed sketch



The process where eraser is streached and air went inside the pore

Chapter 3

3 Design development and Visual language

Here I started generating visuals digitally on the bases of a doodle, and sketches I have already made. I have used the adobe software like photoshop, illustrator, etc.

3.1 Design Guidelines

for Development of Poster

3.1.1 Color

Colors play a very important role in communicating. It also convey the message to viewers and grab their attention. Colors give a meaning to the image and text which makes them memorable also

Colors can be used to hold attention, guide the reader, intensify a visual message, speed interpretation, accentuate positives, establish mood, make sense and clarify ideas, explain and persuade (Eiseman , 2000 and DiMarco, 2010). Saturation is also called chroma, and it refers to how little or how much gray a color contains (Eiseman, 2000).

Color Harmony

Color schemes used in the poster design is pleasing and engaging, helps to evoke favored emotions for users, create value and enhance product information with a balance visual experience.

Color Contrast

Colors are tested for low lighting situation, color blindness and aging eyes.

Color Impact

Color combinations create impacts on the viewer. Vivid contrast can grab and hold attention and leading eyes for in depth look, without being overpowering or distracting for users.

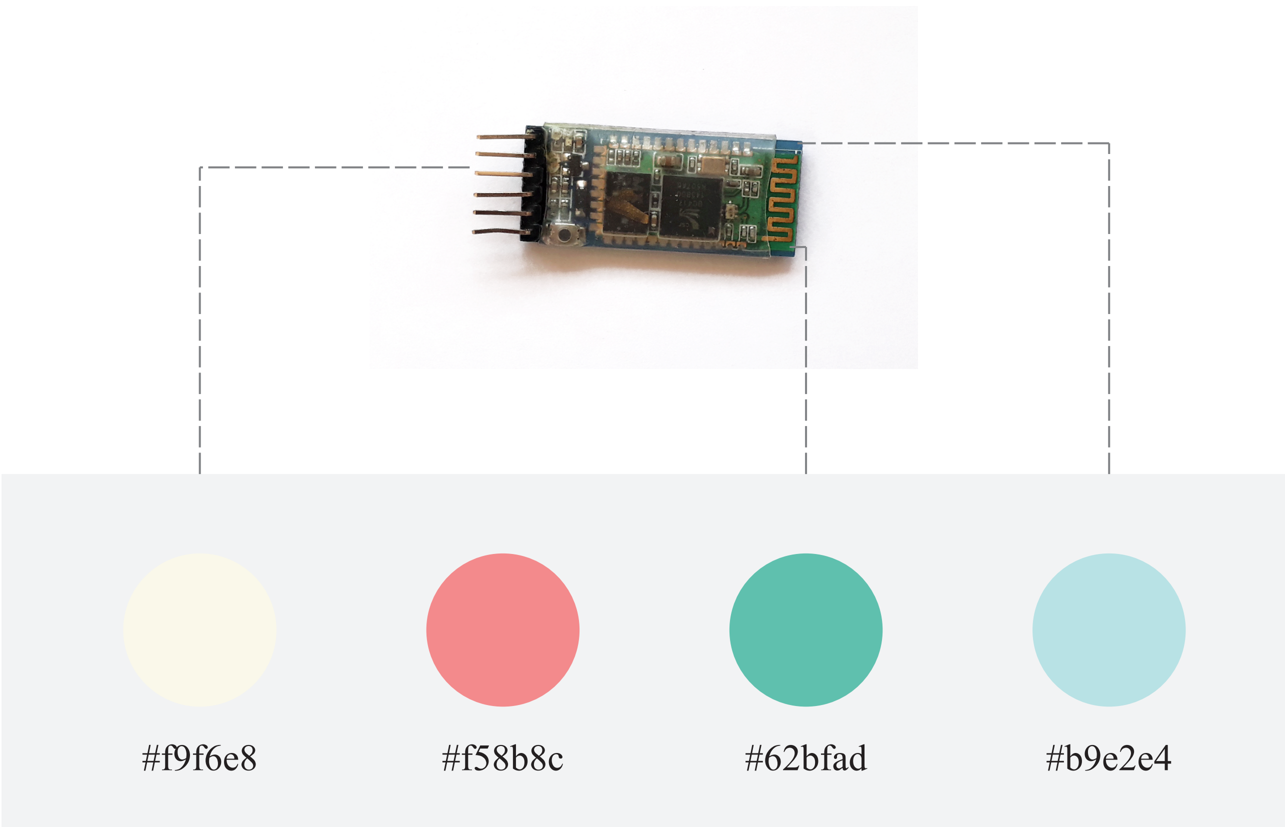
Color-coding

Color-coding is used for grouping information and creating information flow.

3.1.1.1 Color scheme

Color schemes are selections or combinations of colors used to create value contrast (variety) or harmony (unity) (DiMarco, 2010).

The color scheme I preferred here is taken from the electronic chip of that product.



Three colors are picked from the electronic chip where #62bfad (green) color is set as a dominant color in the theme. The reason behind is that whole paper talks about eco friendly and biodegradable things.

Color code #f58b8c is chosen because of a warm nature. I want to introduce some highlight things dominantly for that purpose it stand out the best.

3.1.2 Visual Hierarchy

Visual hierarchy is “an arrangement of elements in a graduated series, from the most prominent to the least prominent, in an area of typographic space.” Repetition, contrast of size, weight, color, tone, texture and spatial interval can create a hierarchy. Location and special relationships are very important in the arrangement. When creating a visual hierarchy, harmony, emphasis, and vitality should be considered (Carter, Day and Meggs, 2007).

Posters have complicated information that needed to be displayed in a limited space, including all parts of paper, abstract, introduction, experiment, results, conclusion etc. Visual hierarchy on poster could reduce information overload and anxiety.

Abstract

Abstract is considered the most viewed part because it is on the first, such as more noticeable all the time. The information here should be very clear which make viewer to lead to the whole part of the poster.

Introduction

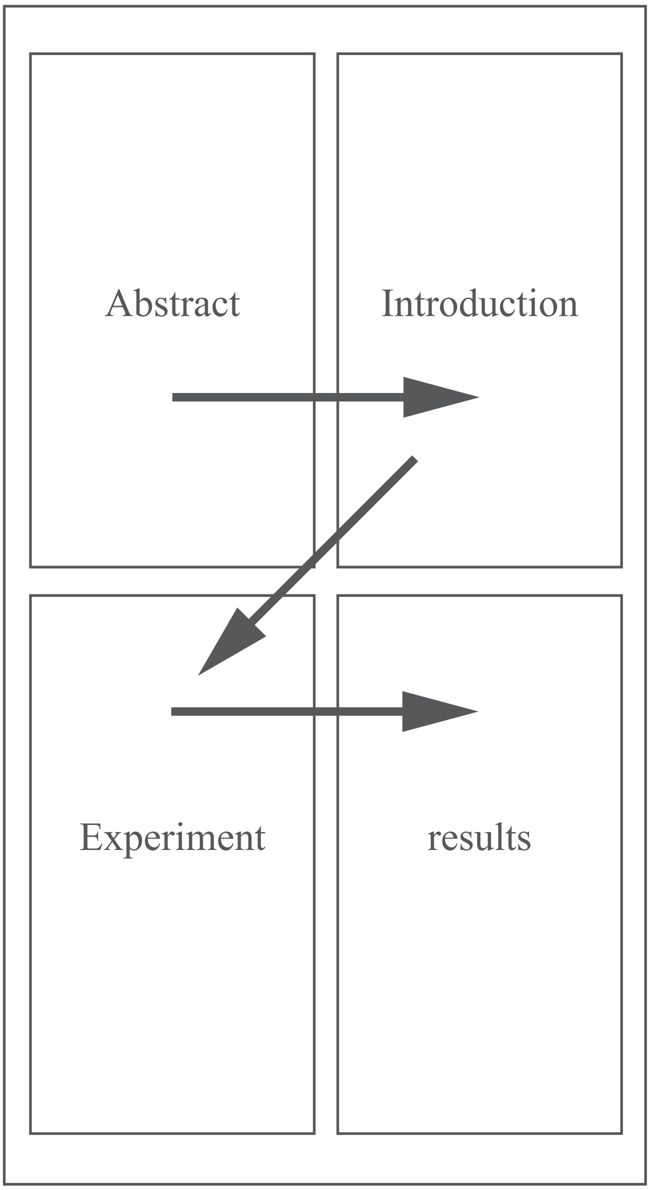
Introduction often has more simple part than abstract because it gives only the introduction of the paper rather than giving brief which make things complex. Poster tend to have a more balanced content with all the sections. Previous posters include lots of text here in this section.

Experiment

Experiment is usually considered as the most important as well as the most noticeable section of the poster. Our target viewers wants more attention here as it is a section which define the full process of the research paper. The placement should be accordingly on the poster.

Results and discussion

This is the last section of the poster. The placement is pretty defined here.



3.1.3 Typography

Readability

Readability is "type's capacity to attract and hold a reader's attention by engaging the viewer with a strong typographic visual", and it "adds aesthetic value to a design piece and makes it noticeable and interesting to the viewer." Readability is important for display typelike headlines (DiMarco, 2010).

Legibility

Legibility is "type's capacity to deliver a message to the reader." It is the crucial aspect for body copy because text type focuses on communication rather than drawing attention (DiMarco, 2010).

When designing for infographic posters, the dimension of poster must be consider. Typefaces with fine details such as fine serifs, ultrathin strokes, small counters and other visual eccentricities may reduce legibility when color is not carefully chosen (Carter, Day and Meggs, 2007).

Typography

Body copy should be set in a typeface no smaller than twelve points with at least three points of leading between the lines for maximum readability. Readability is increased when uppercase letters are only used for heads and subheads, and lowercase letters are used for the majority of the menu text. Typefaces should be selected to match the character of content, using strange, exotic typefaces sparingly.

Type, if in a color, should always be in a dark color that creates a high contrast between the type and the paper. Uppercase letters and italics are tiring to the eye and hard to read in large amounts, so should be used sparingly, to add emphasis (Seaberg, 1991).

Type Styles

Type styles include roman, regular, bold, semibold, italic, book, oblique, heavy, black, condensed, thin, and bold italic. Typefaces can be divided into six main categories: Serif, sans serif, Slab serif, Script and cursive, Black letter, decorative and symbol (DiMarco, 2010).

Choosing the font "futura"

I like the combination of futura bold and light which makes the things stand out and make to focus on the important thing. Futura extra bold is consider ad headline which is very important parts of my posters and I can use futura condensed if I want to fit lot of words in small space.

3.1.4 Layout

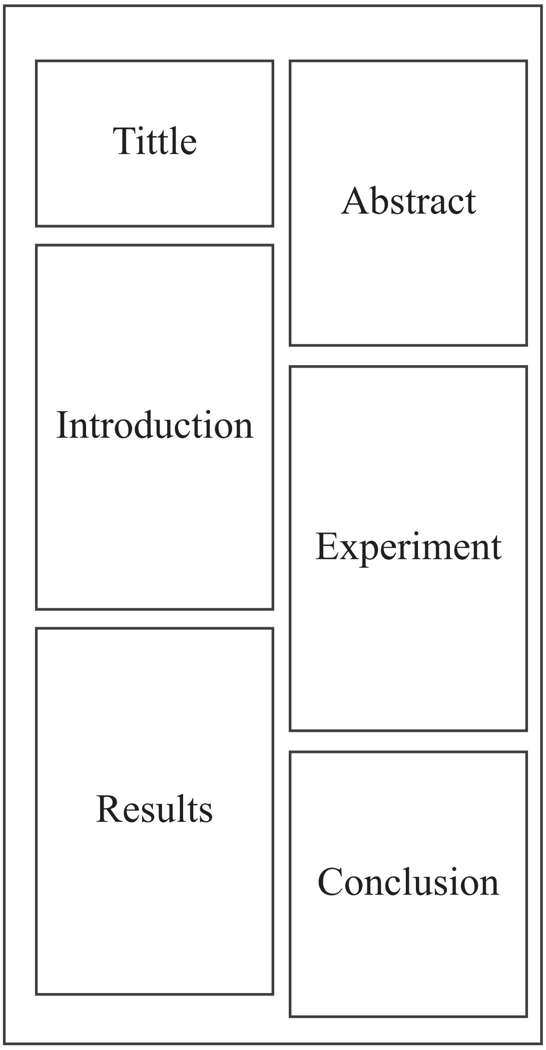
Layout

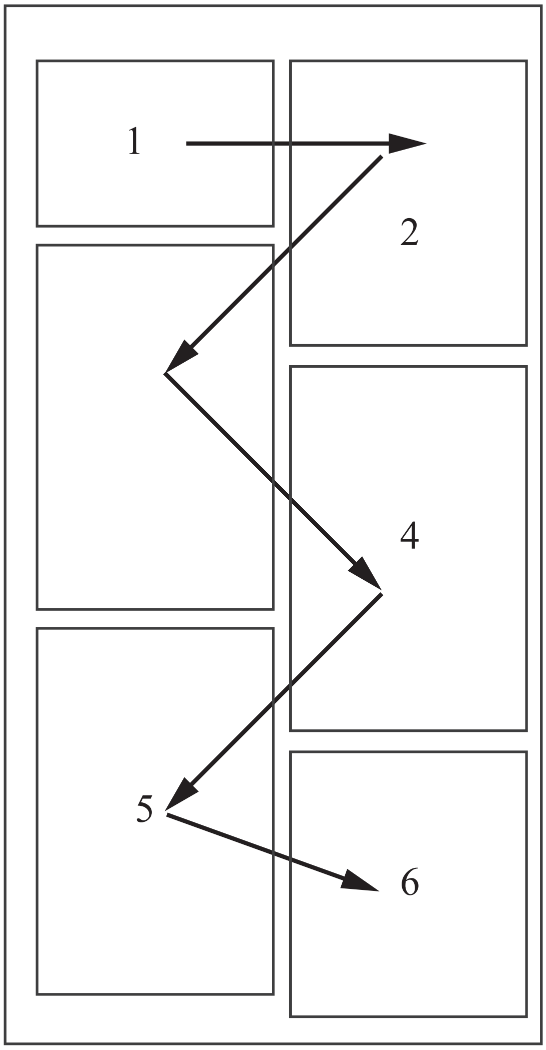
Layout is one of the key components in poster design. Early poster design drew inspiration from newspaper layout, which was to display the most important articles at the top right of the front page, where the eyes tend to be drawn.

Successful poster should have decent amount of whitespace, which makes it more clean and balanced. The use of images makes it much easier.

Layout exploration

Once my content was finalized I started giving shape to them in the form of layout. I took rough idea of the space can be given to the content in poster and started exploring the layouts. I have shown below one of my layout exploration in a diagram which I later finalized for the prototype.

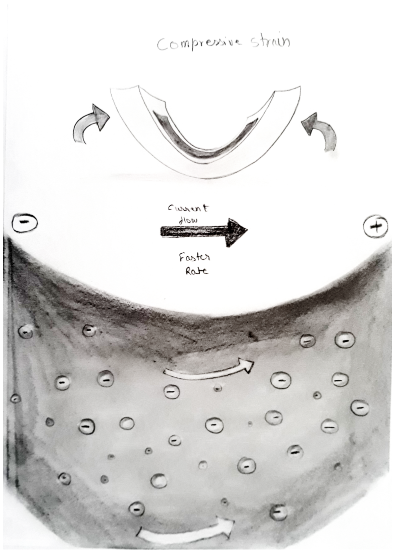


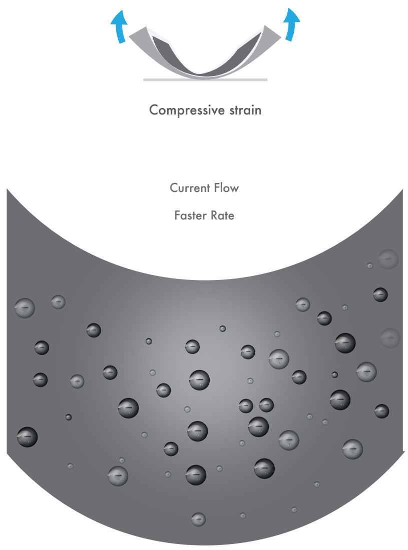


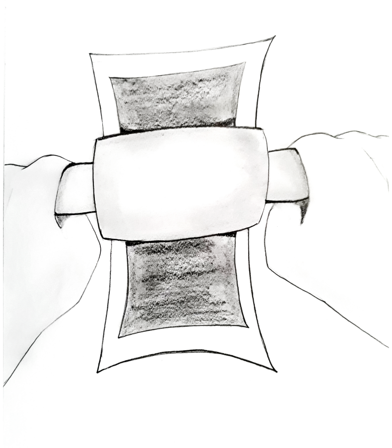
3.2 Evolution of visuals

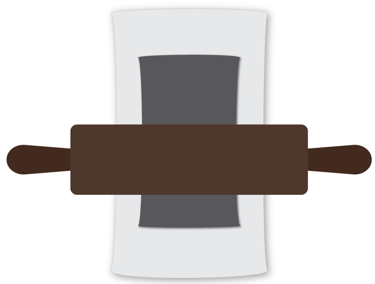
Illustration on software

The exploration was rendered in the form of sketches and then the sketches converted into the illustration with the help of adobe illustrator

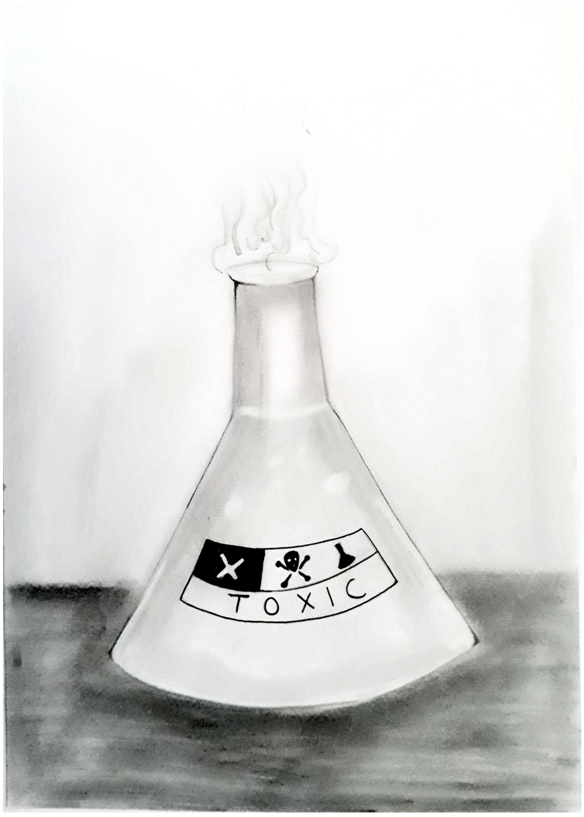


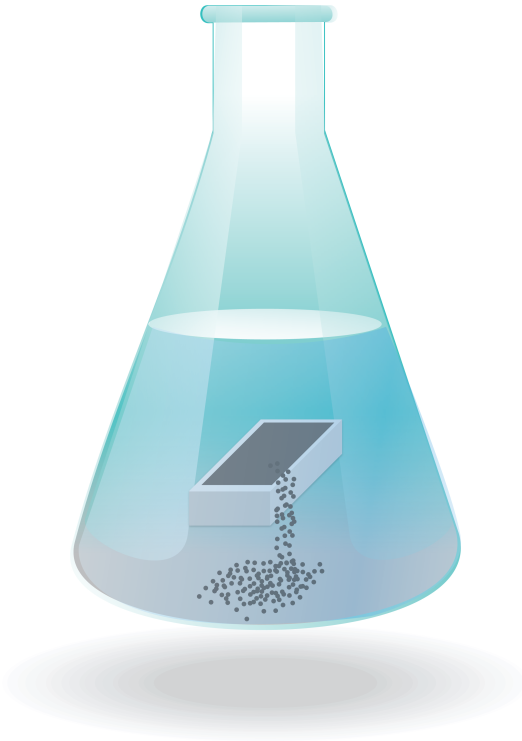




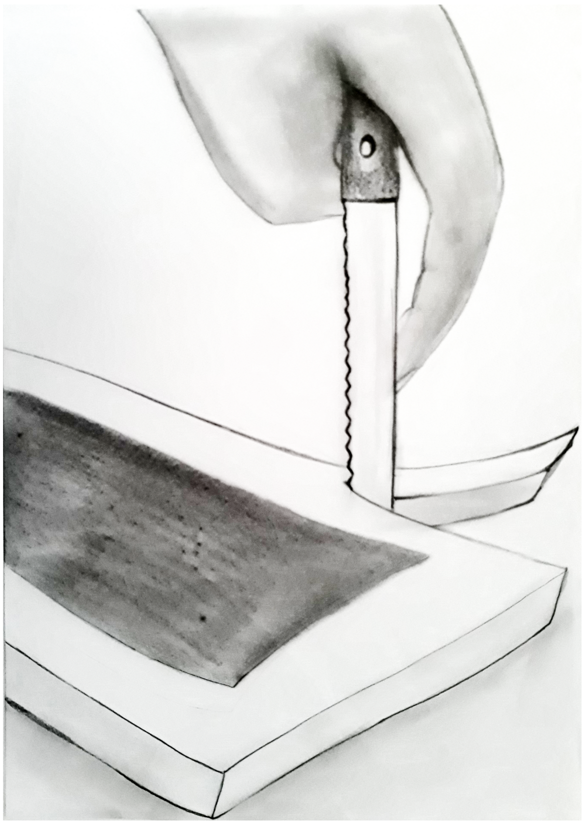


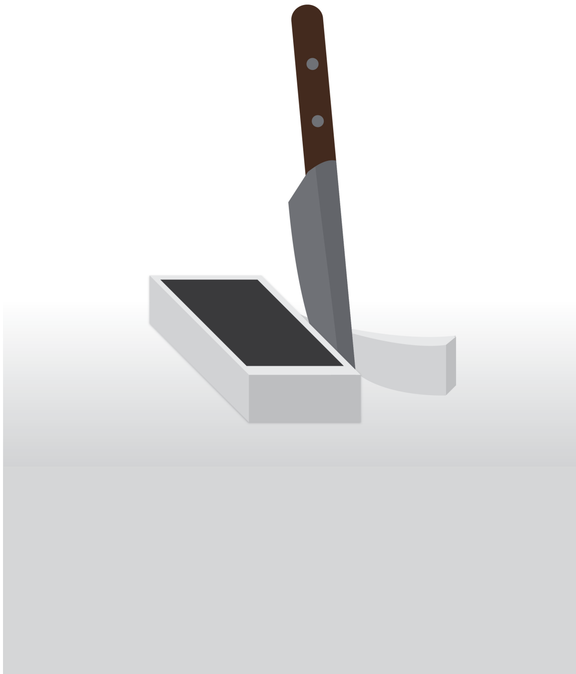
Sketch	Illustration

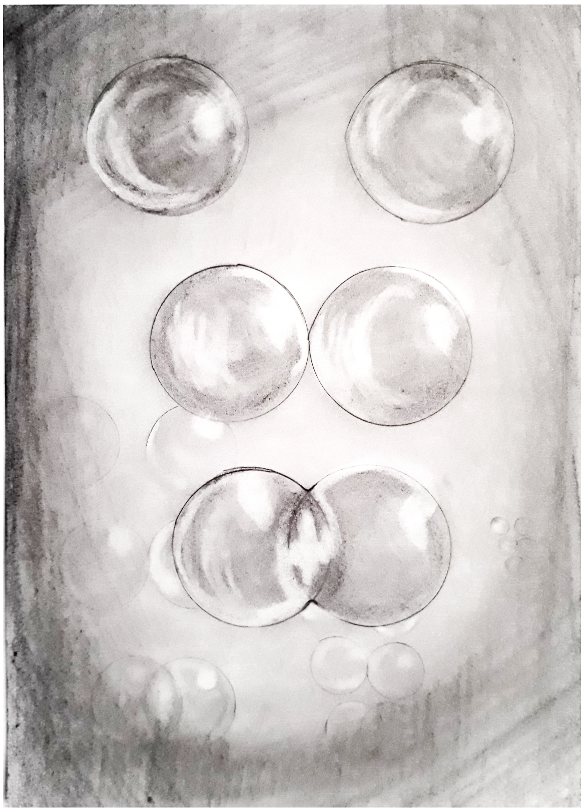


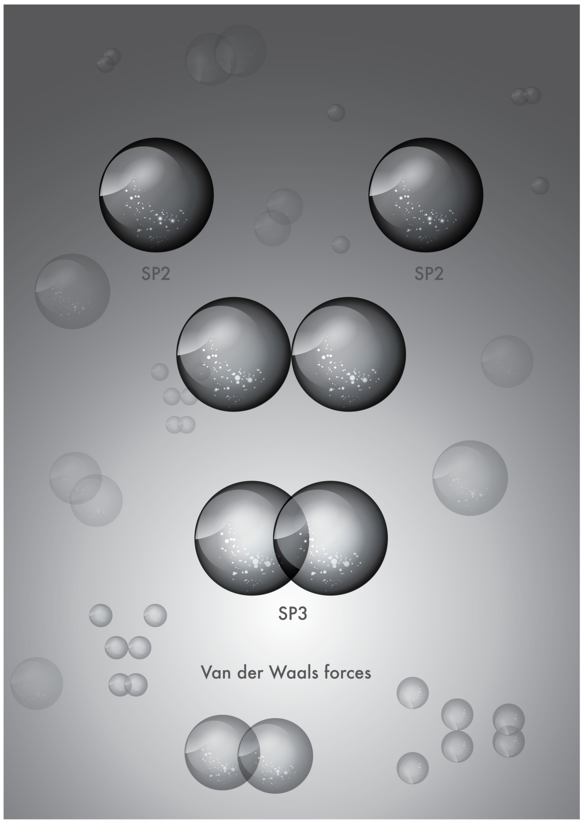


Sketch	Illustration









Sketch Illustration

3.3 Making of icons

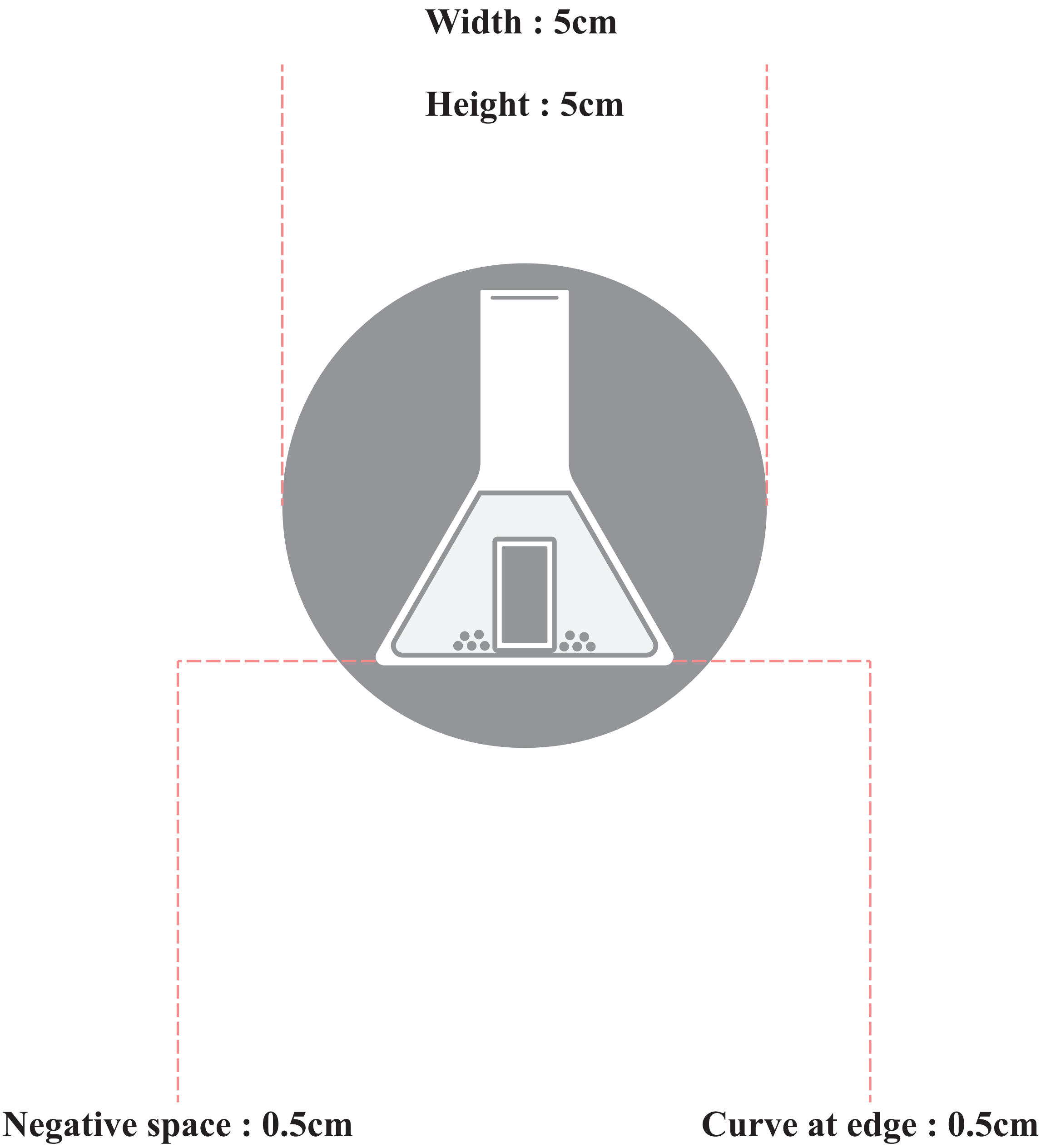
Icons are the powerful tool of the poster which convey a large amount of data in a form of visual. The final prototype of this thesis is an infographic poster for which icons are the most important part.

Anatomy of icon

Icon can be in many forms and shape, I preferred here to be round which is good to be scalable. The icons are flat icon where information can be visible through a negative spacing.

Dimensions

Icons are the one which is a basic need of an infographic poster, and this poster has a dimension of 3 by 4 feet which is quite big poster. Such a big poster needs big icons to convince our viewers. Here icons are made round so that it can be resizable.


Width : 5cm
Height : 5cm
Negative space : 0.5cm
Curve at edge : 0.5cm

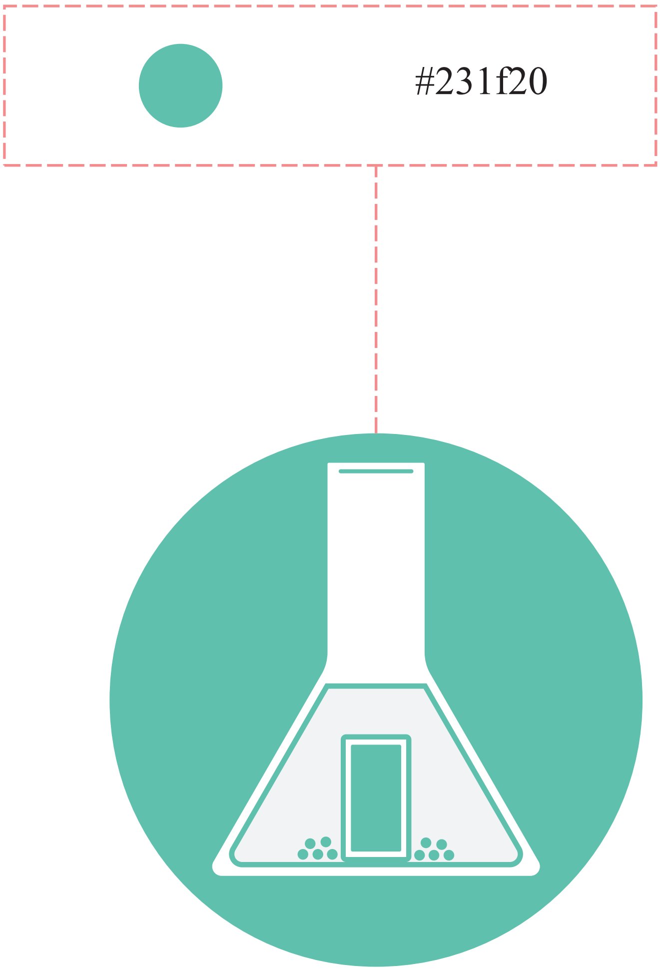
3.3.1 Color Selection

I have already set the overall color theme on the basis of electronics chip. There are several reasons of picking color code #62bfad :

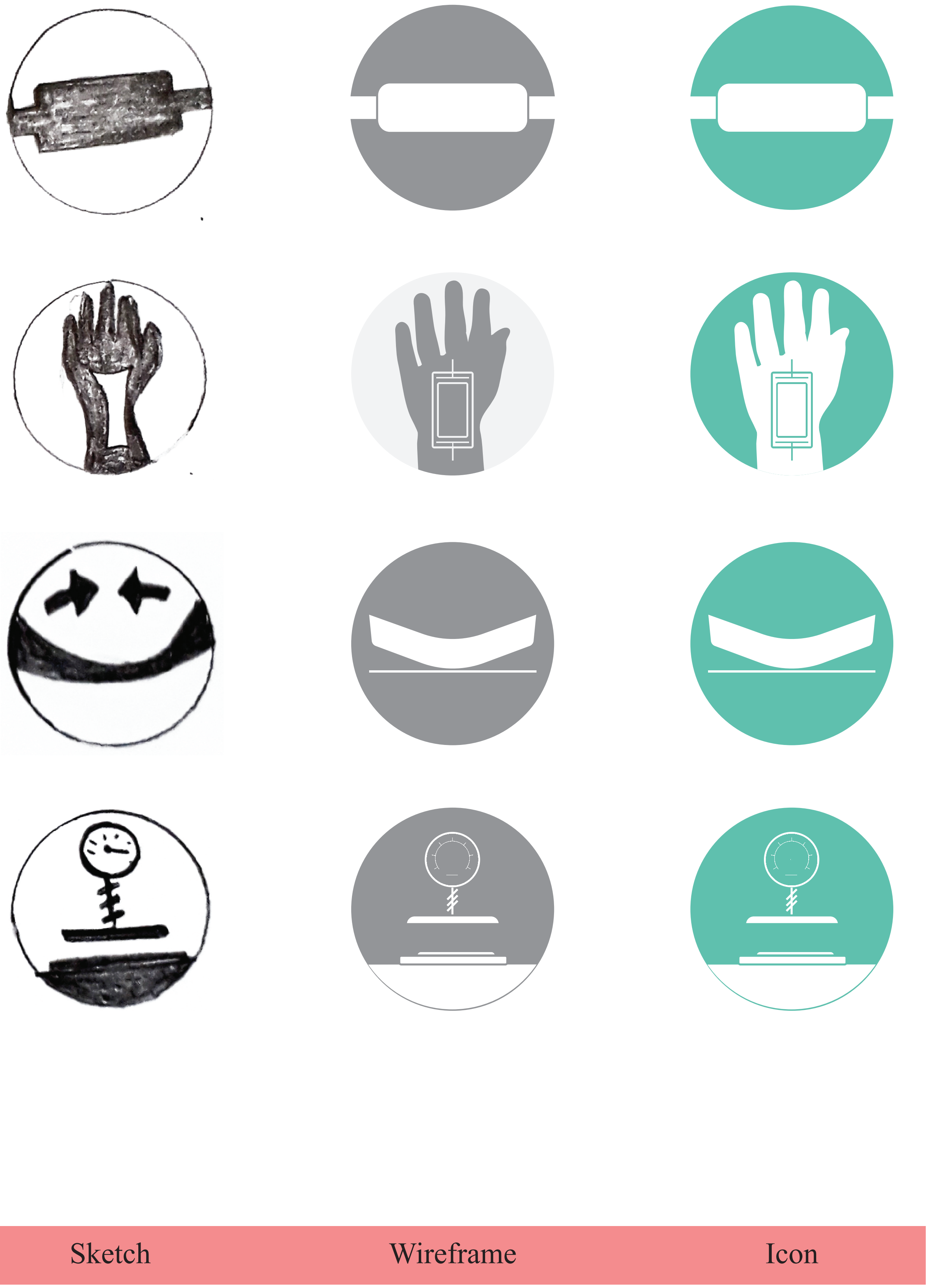
-The whole paper talks about the biodegradable products and eco-friendly

-This color helps to emphasize the negative space which is the subject of an icon as well as distinguished from background color.

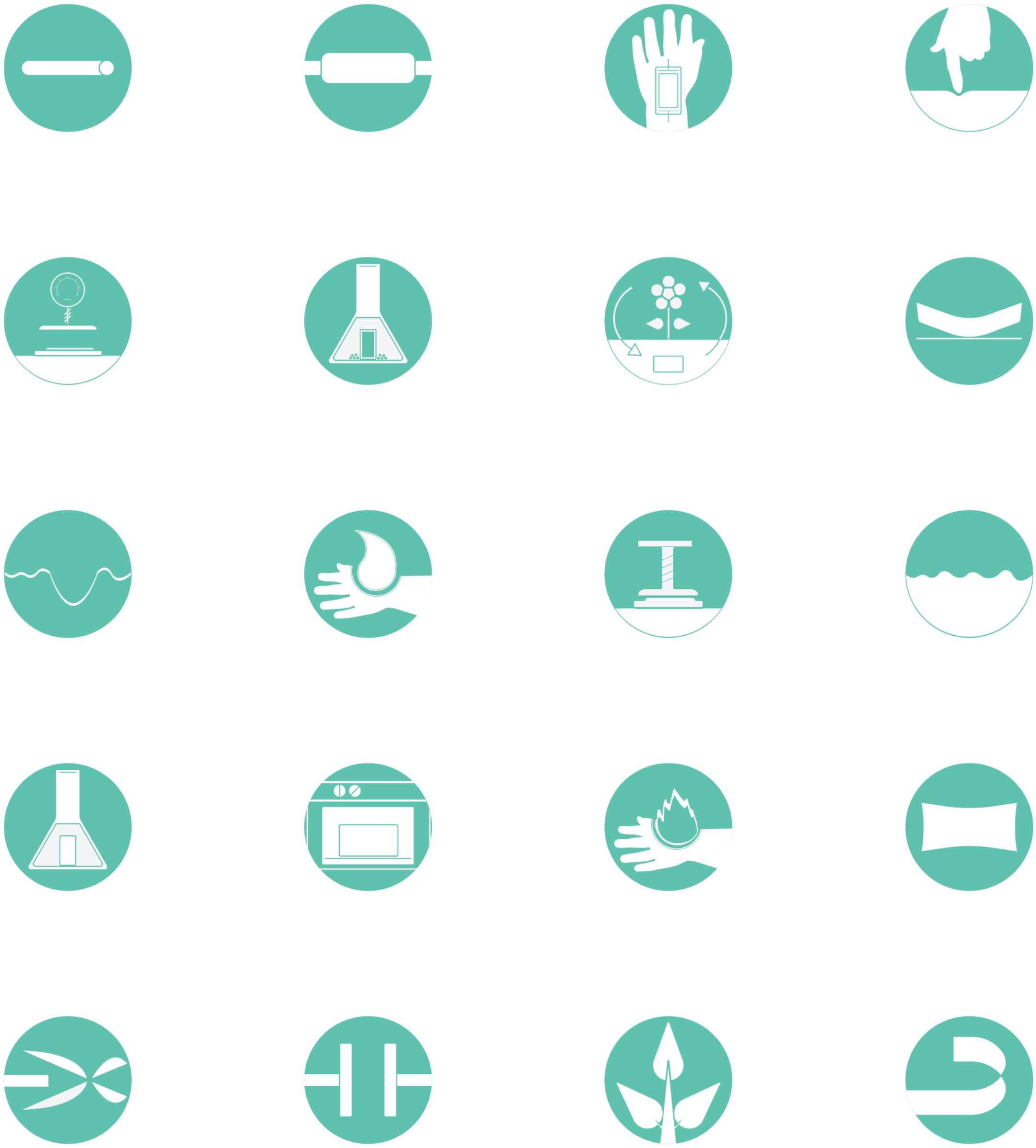
-This color is fall under the category of a cool color which is very pleasant to the eye.



3.3.2 Building icons

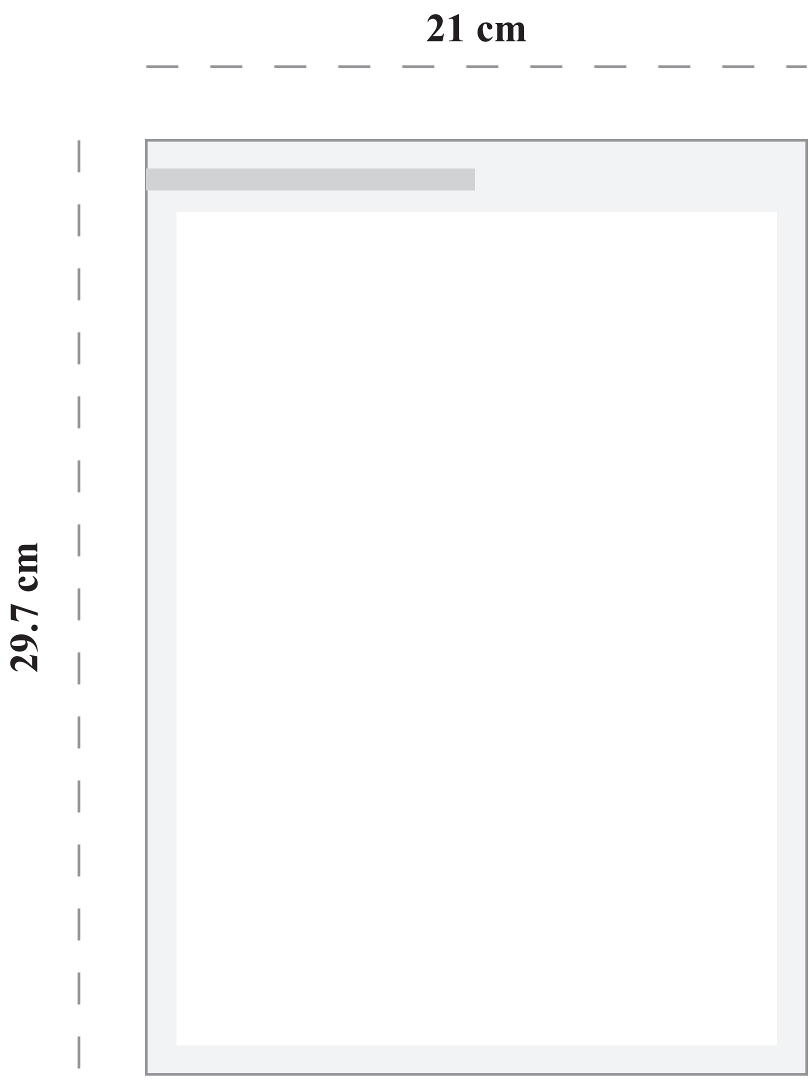


3.3.3 Set of icons

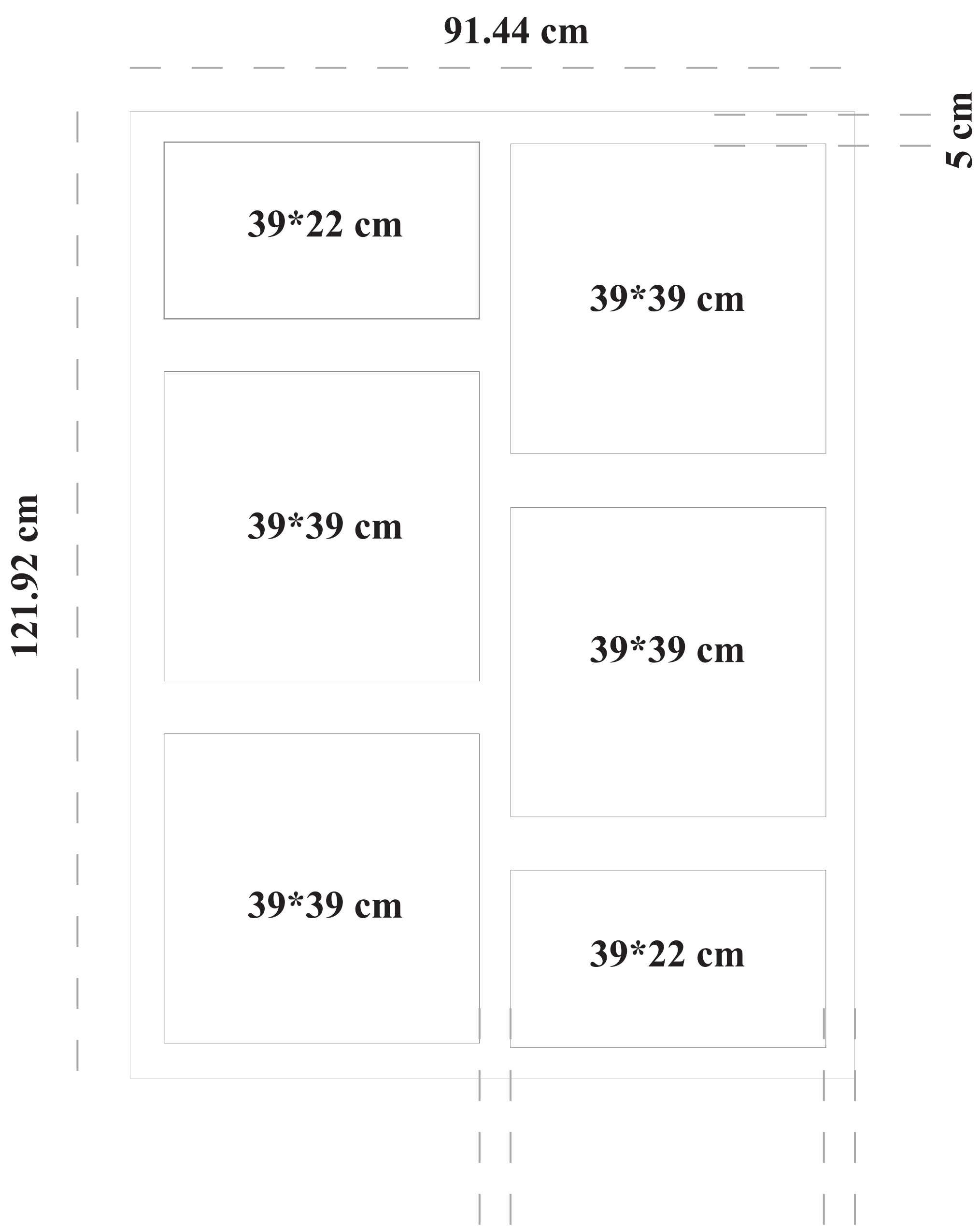


3.4 Dimension

3.4.1 Dimension of the visually narrative paper



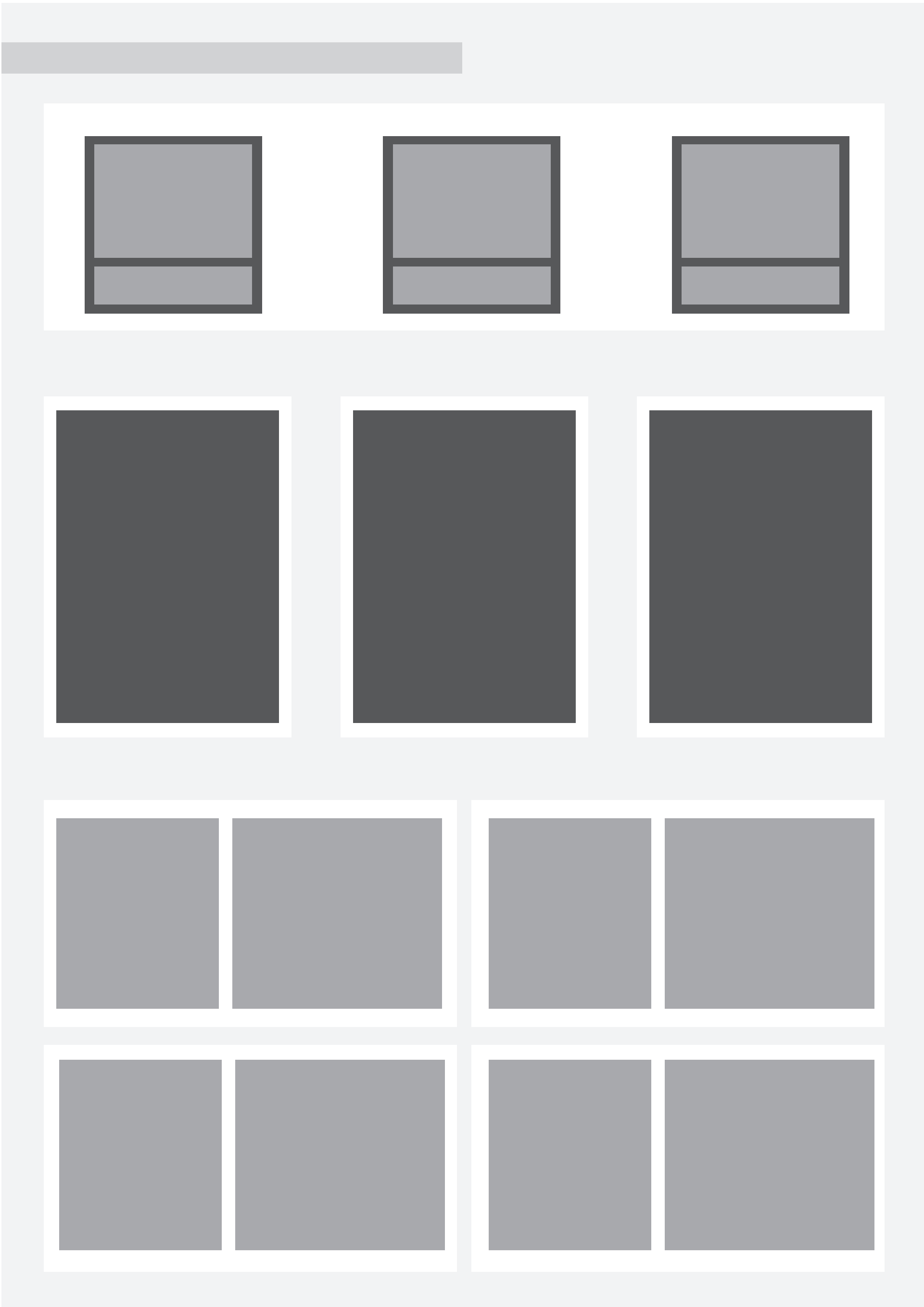
3.4.2 Dimension of infographic poster



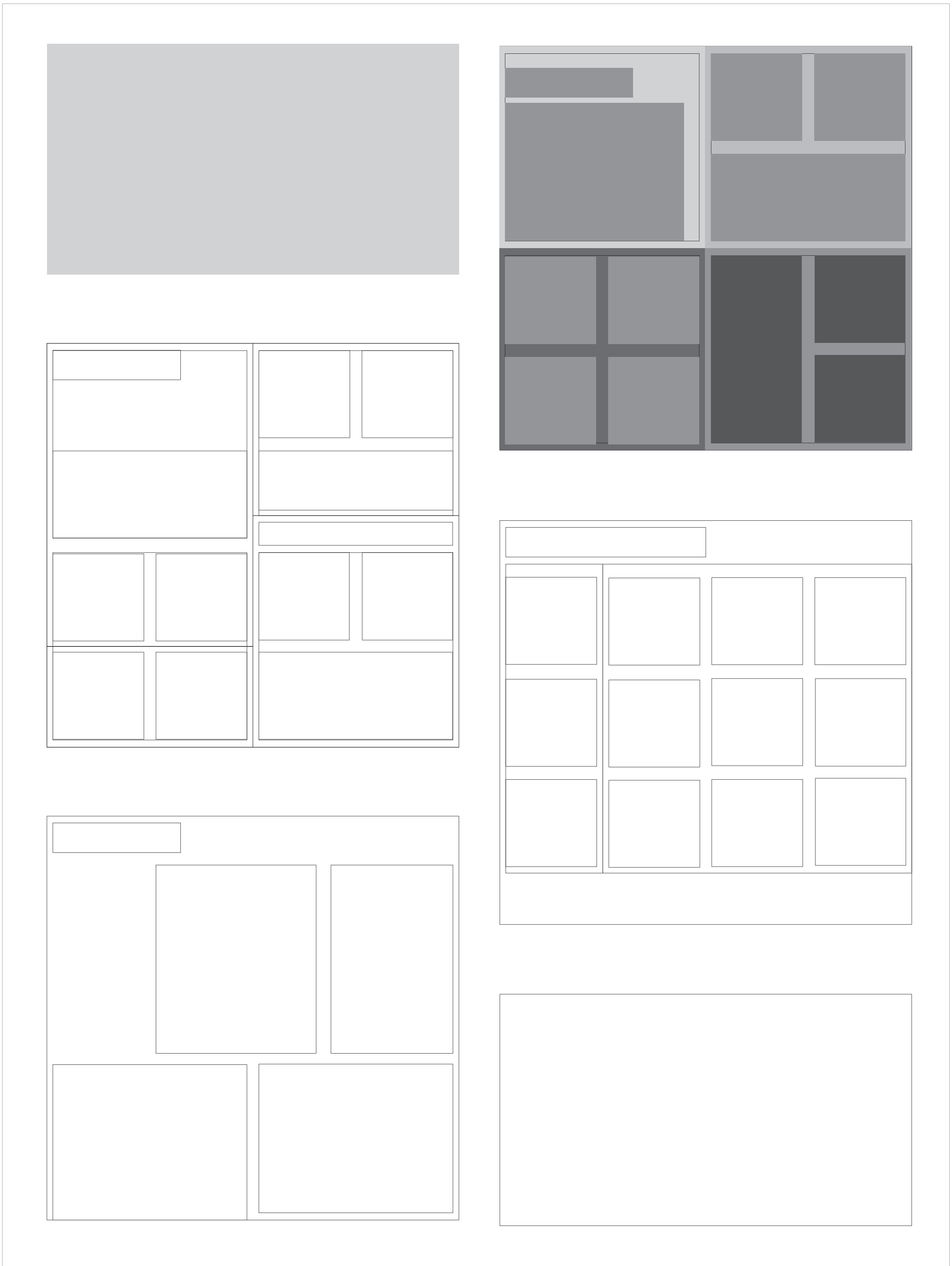
3.5 Grid

Grids are made on the basis of gestalt principles, similar size space is used to show the continuous flow for viewers. There is a leading dashed line which follow the continuous principle. Use of proximity to define the groups.

3.5.1 Grid for the narration of paper



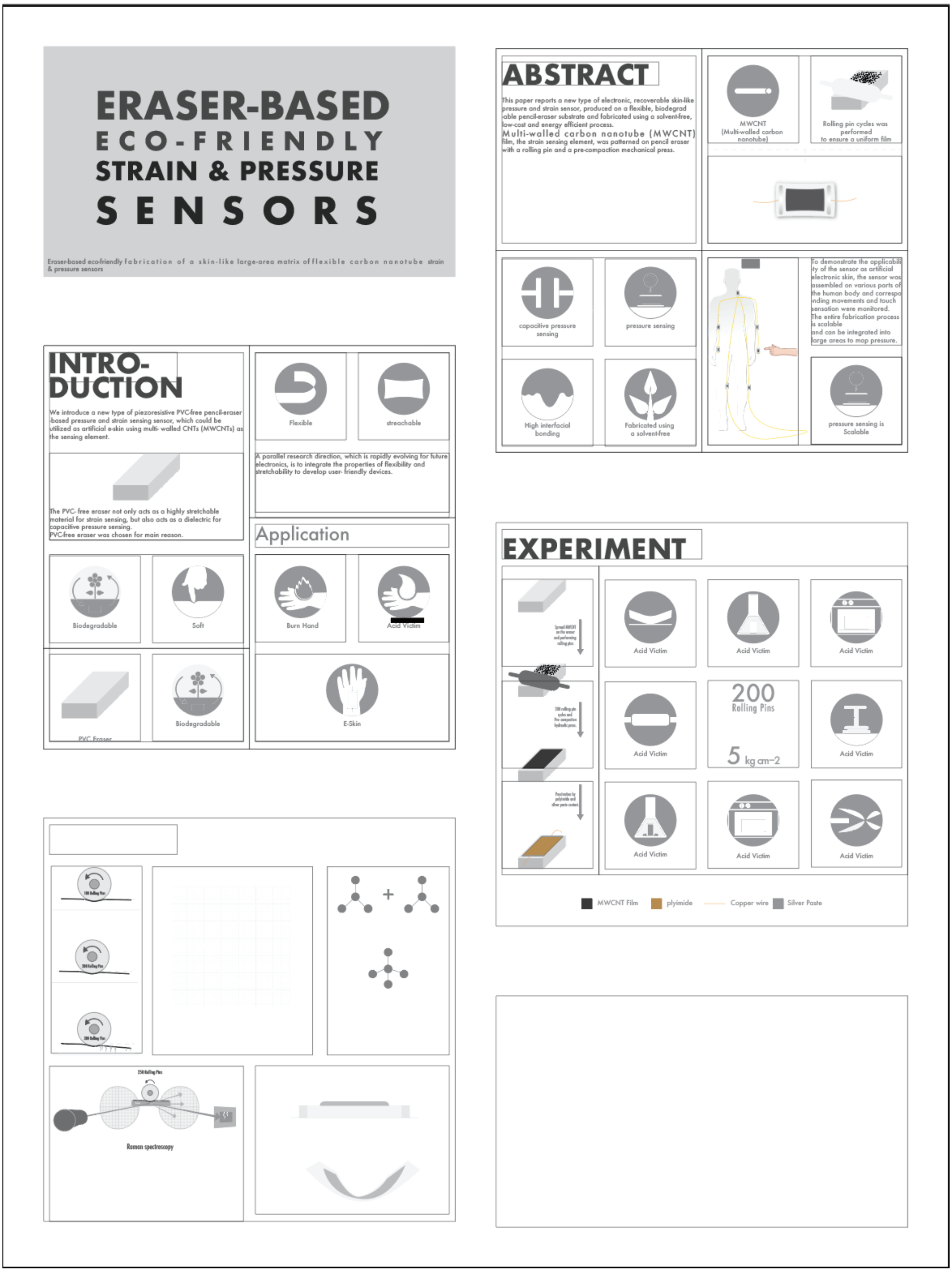
3.5.2 Grid for the Infographic poster



Chapter 4

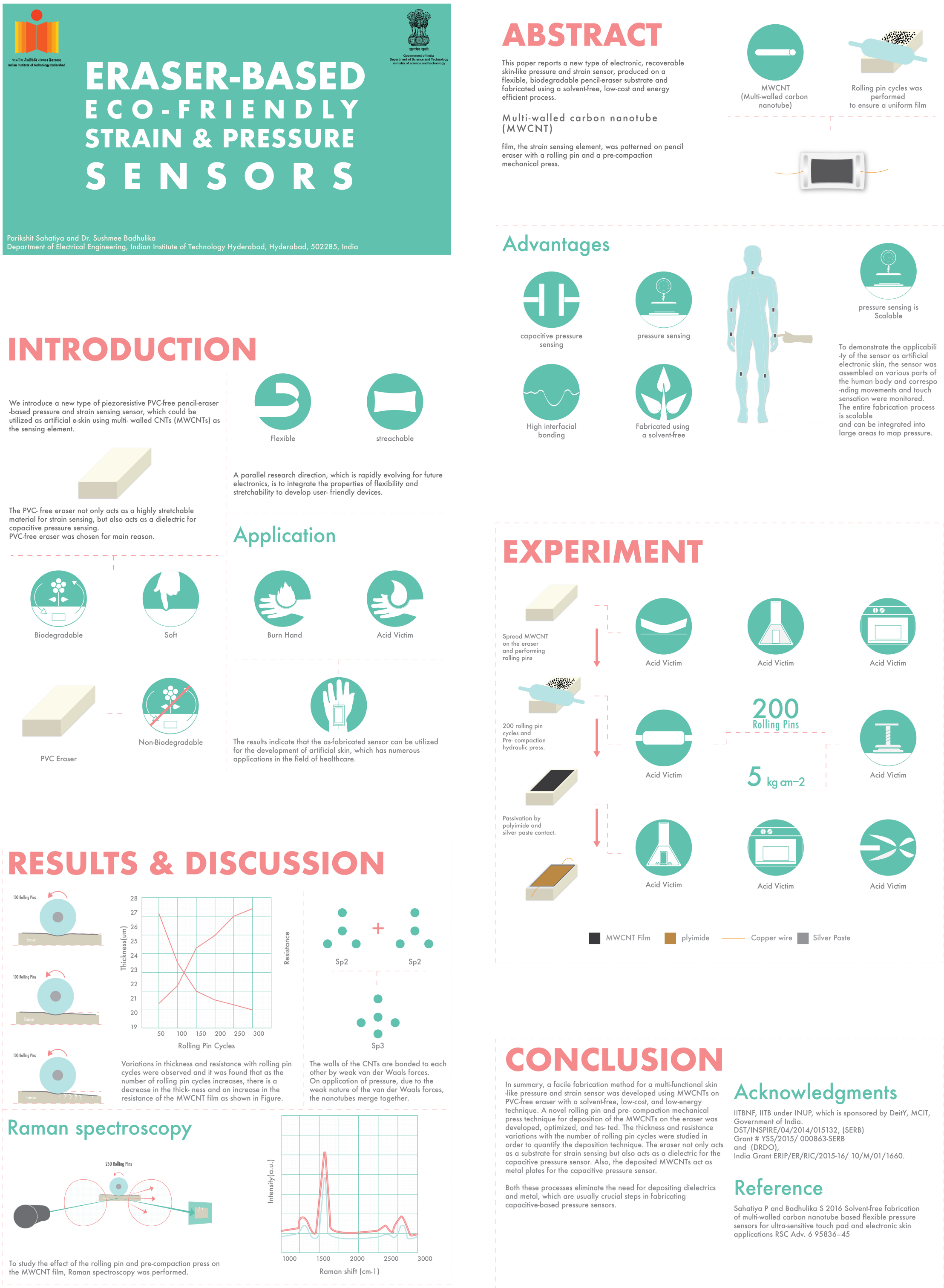
Wireframe and the prototype

4.1 Wireframe of poster



4.2 Execution

4.2.1 Infographic poster



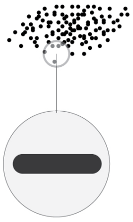
4.2 Execution

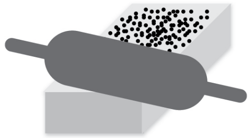
4.2.1 Visual narration of paper

Nanotechnology 28 (2017) 095501 P Sahatiya and S Badhulika

1

Abstract





Rolling pin cycles was performed to ensure a uniform film

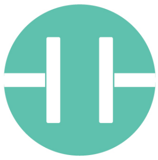
PVC-free eraser

Multi-walled carbon nanotube (MWCNT) film, the strain sensing element, was patterned on pencil eraser with a rolling pin and a pre-compaction mechanical press.

Strain and pressure sensor device

The gauge factor of the strain sensor was calculated to be 2.4, which is comparable to and even better than most of the strain and pressure sensors fabricated with more complex designs and architectures. The sensitivity of the capacitive pressure sensor was found to be 0.135 MPa−1..

Benefits



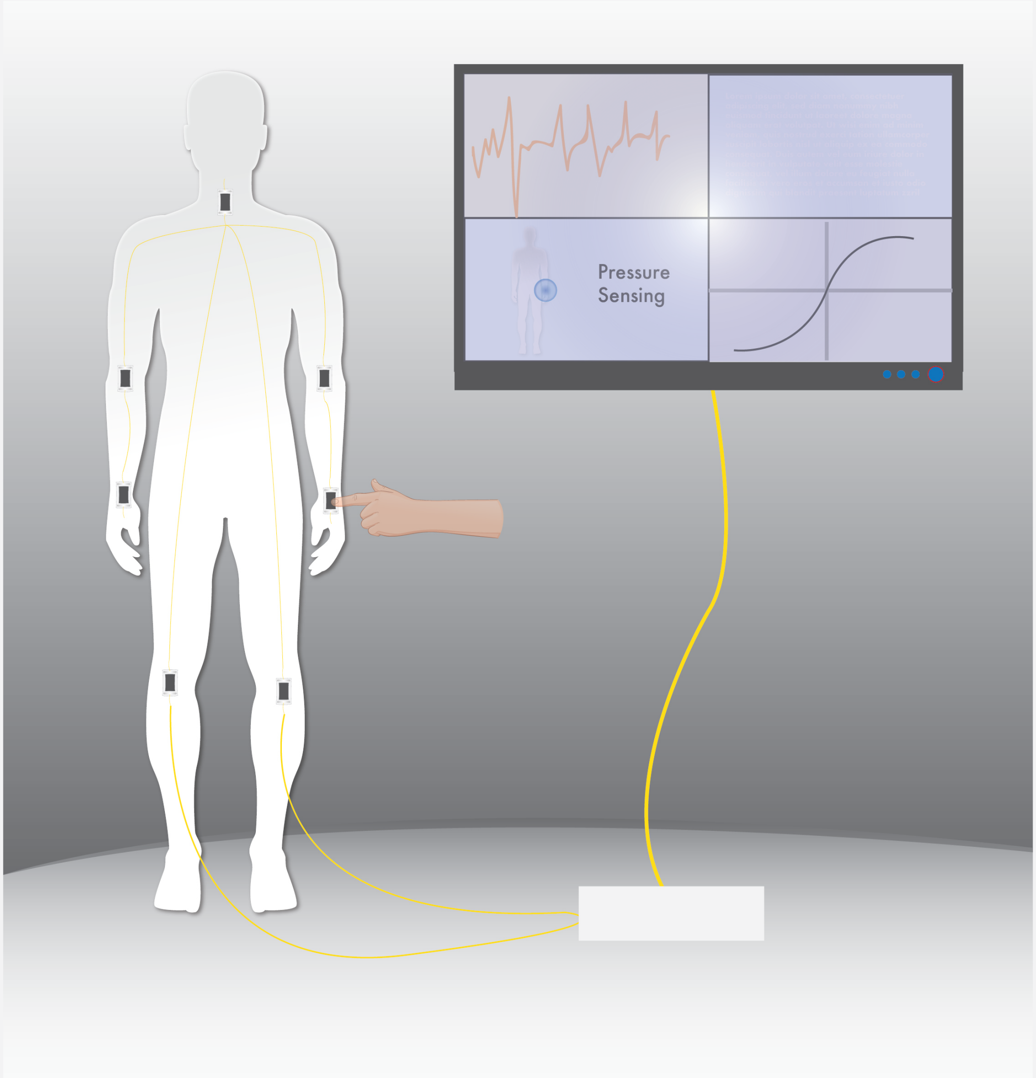
The eraser acting as a dielectric for capacitive pressure sensing, thereby eliminating the dielectric deposition step, which is crucial in capacitive-based pressure sensors..

The eraser serves as a substrate for strain sensing. The sensitivity of the capacitive pressure sensor was found to be 0.135 MPa−1..

This induces high interfacial bonding between the MWCNTs and the eraser substrate, which enables the sensor to achieve recoverability under ambient conditions.

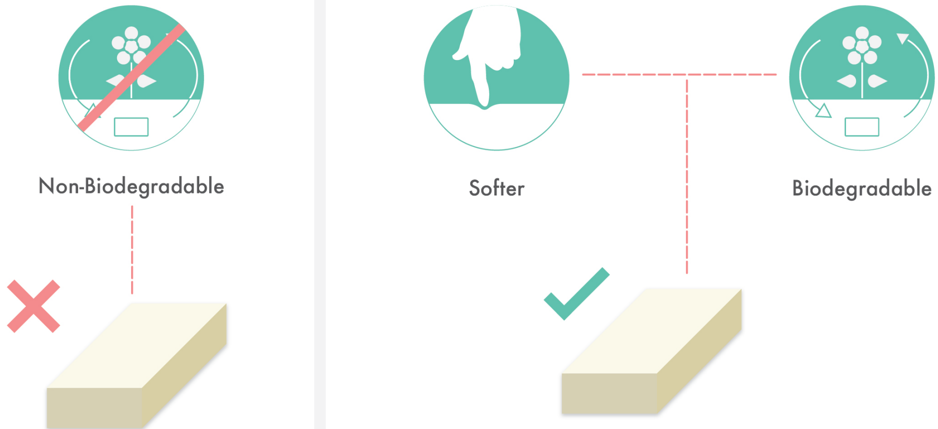
The product is made up of biodegradable pencil-eraser substrate and fabricated using a solvent-free, low-cost and energy efficient process.

Demonstration



To demonstrate the applicability of the sensor as artificial electronic skin, the sensor was assembled on various parts of the human body and corresponding movements and touch sensation were monitored.
The entire fabrication process is scalable and can be integrated into large areas to map spatial pressure distributions.
This low- cost, easily scalable MWCNT pin-rolled eraser-based pressure and strain sensor has huge potential in applications such as artificial e-skin in flexible electronics and medical diagnostics, in particular in surgery as it provides high spatial resolution without a complex nanostructure architecture.

Introduction



Most commer- cially available erasers contain polyvinyl chloride (PVC) which is not biodegradable.

PVC-free eraser was chosen for two main reason, the first being that it is softer compared to other commercial PVC-containing erasers, and second, it is biodegradable. A softer eraser is more easily bendable and induces more strain. Various stretchable devices have been fabricated on rubber using different materials and their composites

Application

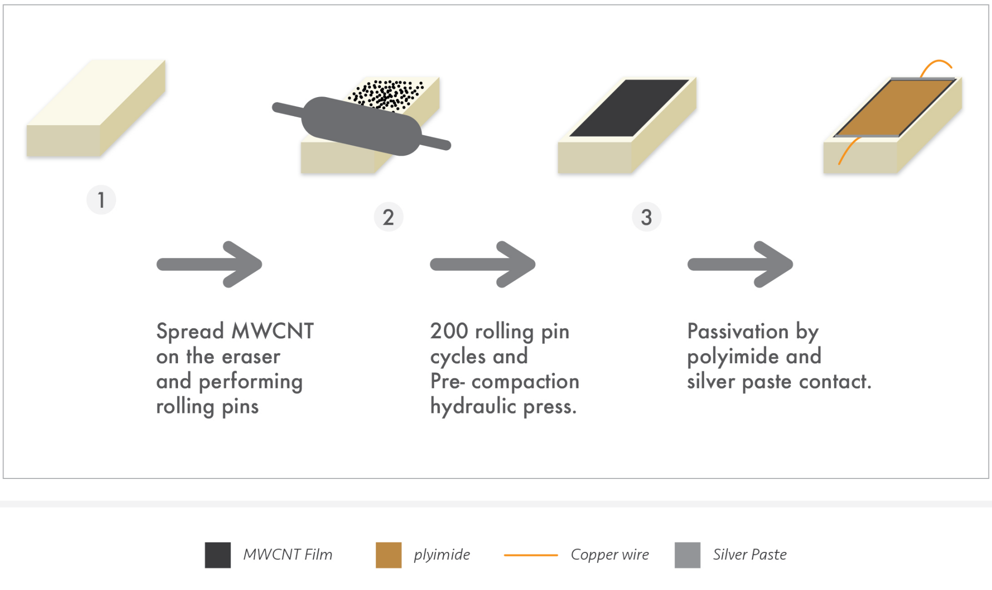
Burn hand

Acid victim

The results indicate that the as-fabricated sensor can be utilized for the development of artificial skin, which has numerous applications in the field of healthcare for acid and burn victims, robotics etc. Moreover, as this is a fully solvent- free technique, the device can be used in developing dis- posable sensor applications where cost is a limitation..

Experiment

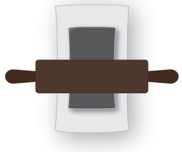
Fabrication of the eraser-based strain sensor



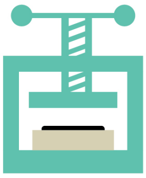
1 Bending and cleaning of eraser

MWCNTs were deposited on PVC-free eraser using pre- compaction mechanical pressing and a rolling pin. The eraser was pre-stretched and bent several times to relax the strain and open gaps for easy deposition of MWCNTs. Before deposition, the eraser was cleaned with de-ionized (DI) water and sonicated in isopropanol (IPA) for 3 min. It was then dried at 70 °C for 20 min.

2 Spreading MWCNT on eraser to make thin film

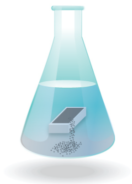


MWCNTs (of different weights) were then applied on the eraser and MWCNT film was formed using a rolling pin. Optimization in terms of process, MWCNT weight, and rolling pin cycles was performed to ensure a uniform film with the desired initial resistance. For accurate fabrication of the device, rolling was performed for different rolling cycles to ensure uniformity in the film.

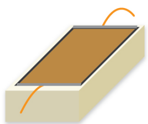


To ensure uniform pressure, the MWCNT pin- rolled eraser was then compressed using a pre-compaction mechanical press with a pressure of 5 kg cm−2 for 15 s..

3 Cutting and cleaning of eraser

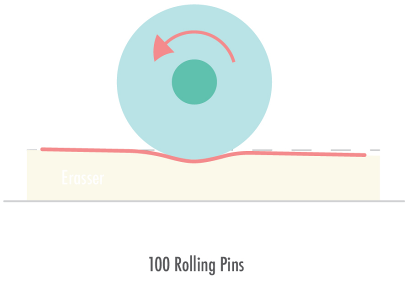


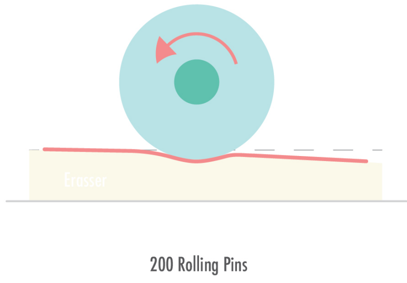
For accurate fabrication of the device, rolling was performed for different rolling cycles to ensure uniformity in the film. To remove the unattached MWCNTs on the eraser, it was washed with a large amount of DI water. The eraser was then dried at 70 °C for 30 min. The eraser was then cut into the desired lengths and widths. The rolling of the pin was performed manually, wherein pressure variations are difficult to control.

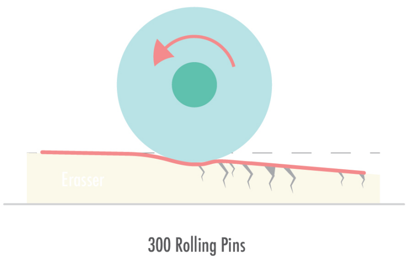


Contacts were then made using silver conductive paste. Finally the eraser was passivated using of PI tape. The resistance of the eraser-based sensor varied with the width and length of the MWCNTs deposited on the eraser and can be found in the supplementary information.

Results and discussion

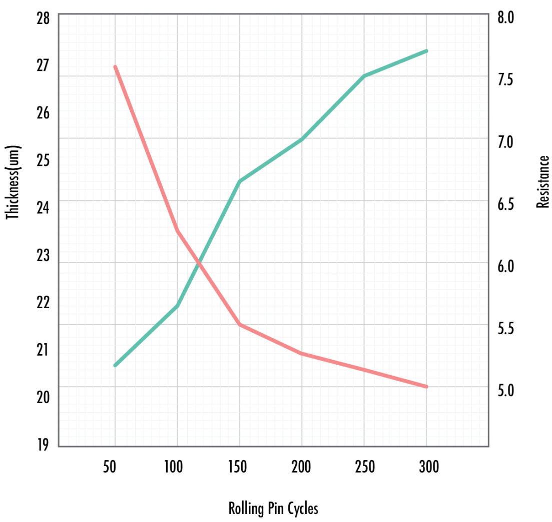


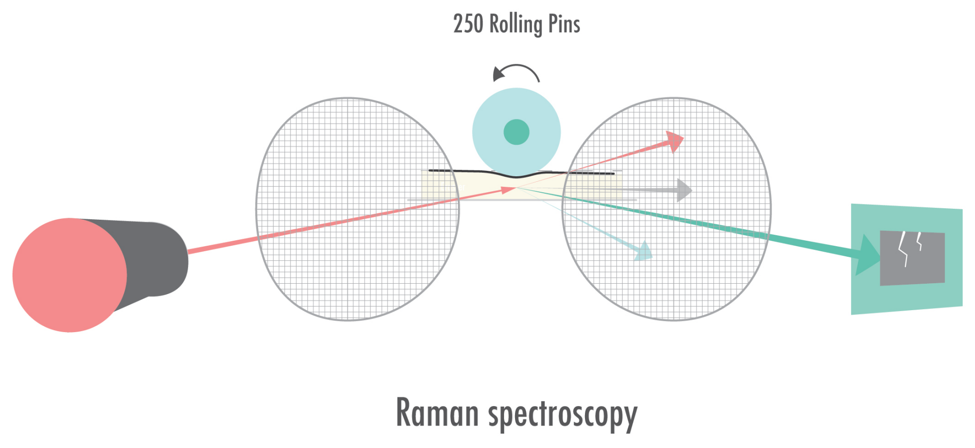


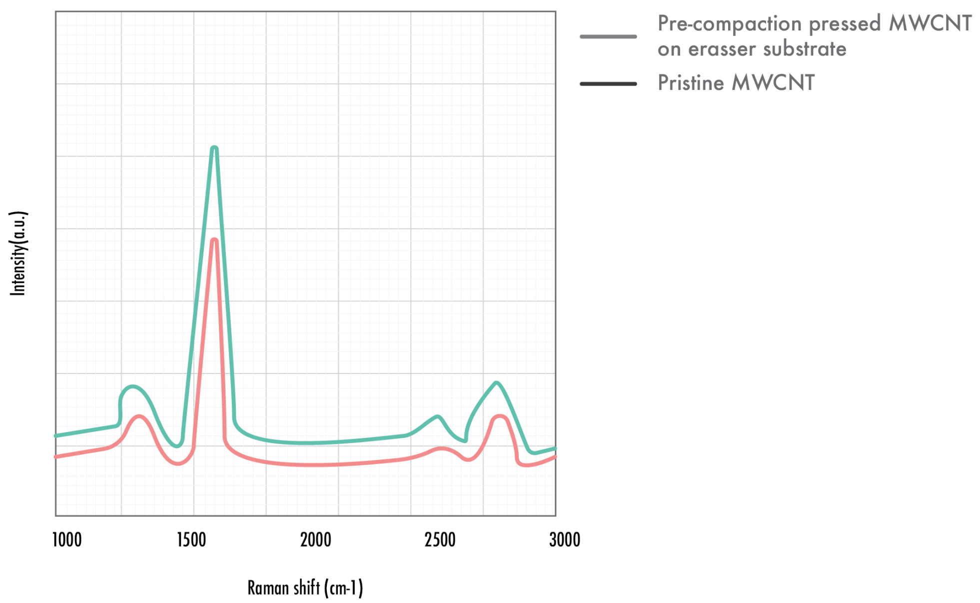


Variations in thickness and resistance with rolling pin cycles were observed and it was found that as the number of rolling pin cycles increases, there is a decrease in the thick- ness and an increase in the resistance of the MWCNT film.
As the number of rolling pin cycles increase from 50 to 300, a 24.3% decrease in the thickness is observed. This is due to the fact that as the number of rolling pin cycles increases, the MWCNT film tends to stretch, which decreases the thickness of the film.

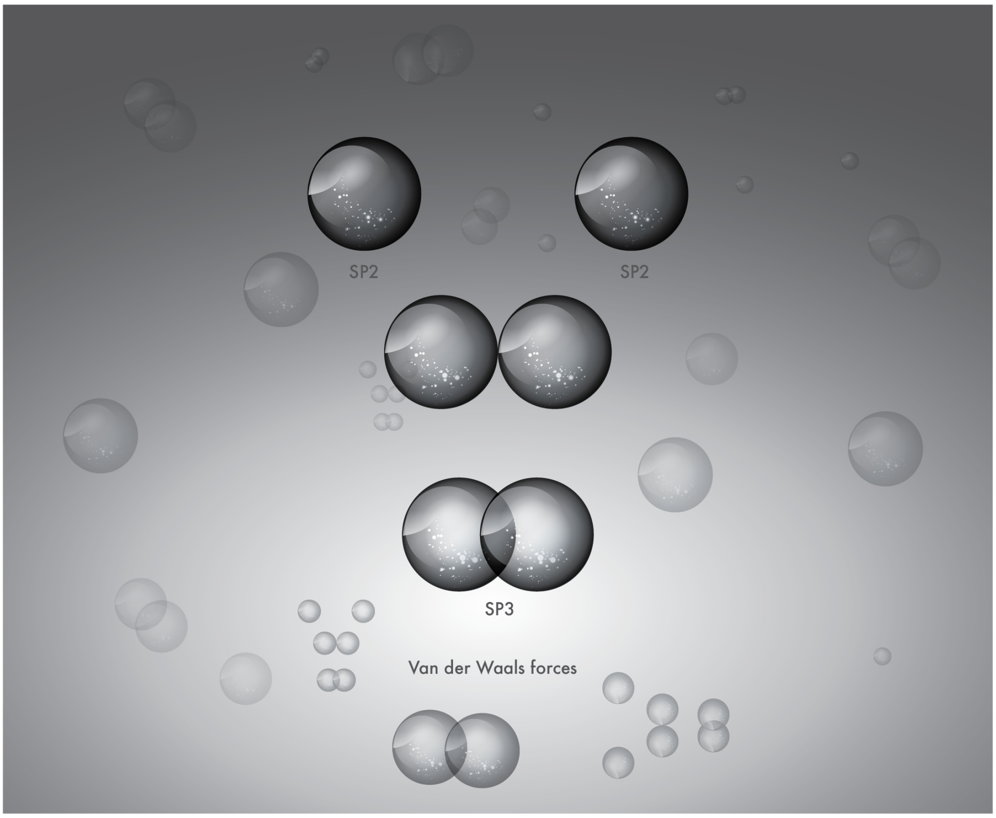
Figure shows the variation of resistance with number of rolling pin cycles; an 83% increase in the resistance is observed. For resistance measurements silver paste was used as the contacts. Due to the decrease in thickness of the film, the MWCNTs penetrate further into the eraser substrate, thereby increasing the insulating nature of the film and hence the resistance of the film increases..

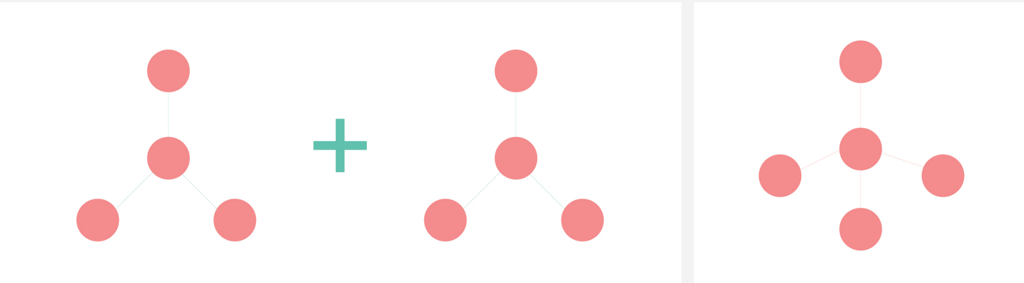






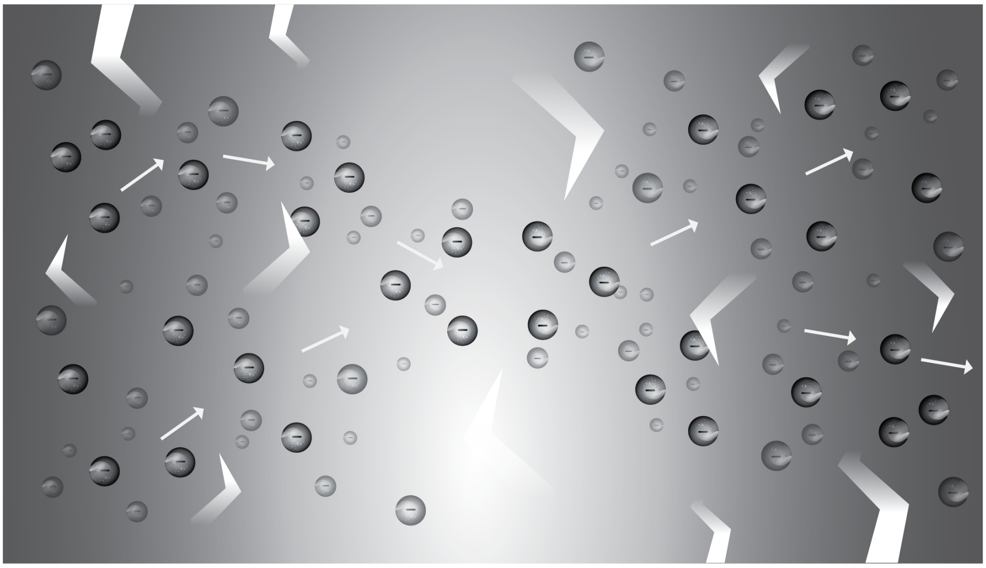
To study the effect of the rolling pin and pre-compaction press on the MWCNT film, Raman spectroscopy was performed.
Typical signatures for MWCNTs were observed for both the pristine and pin-rolled/ pre-compaction pressed MWCNTs



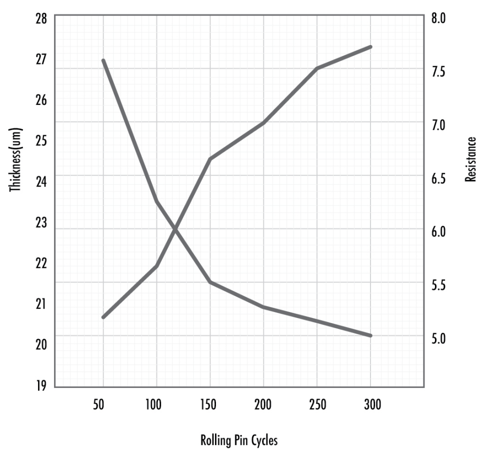


It was found that the pre- compaction pressed MWCNTs retained an sp2 hybridized structure with some defects induced. This was verified by taking the ID/IG ratio of both pristine and pre-compaction pressed MWCNTs. For the pristine MWCNTs the ID/IG ratio was found to be 0.315 while the ID/IG ratio for the pre- compaction pressed MWCNTs was found to be 0.385. The walls of the CNTs are bonded to each other by weak van der Waals forces. On application of pressure, due to the weak nature of the van der Waals forces, the nanotubes merge together, giving rise to sp3 hybridized bonds.

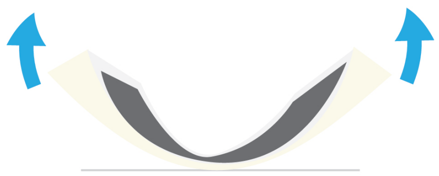
Tensile Stress



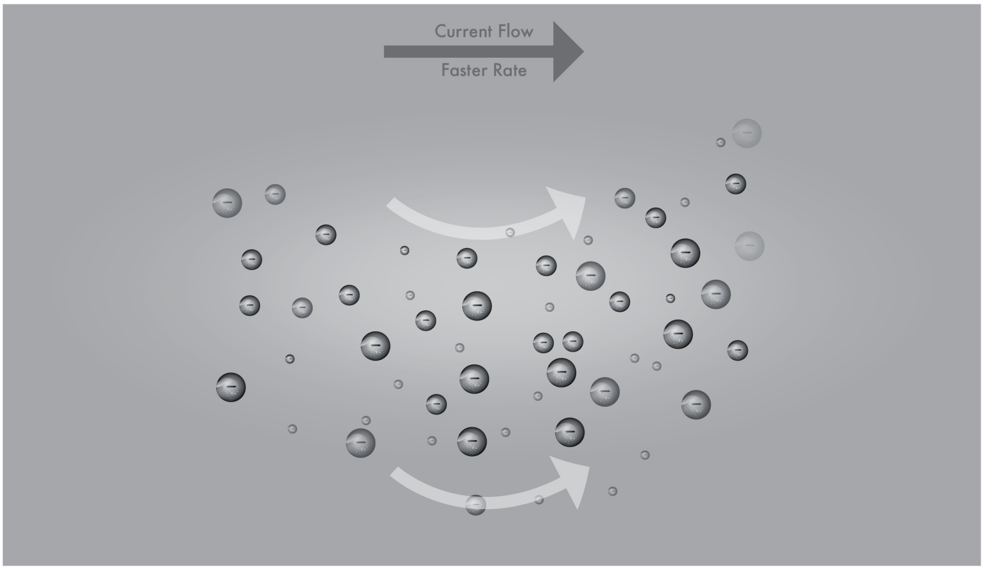
Under applied tensile strain, the MWCNTs tend to form cracks which are occupied either by eraser substrate or by air. Electrons can tunnel through eraser or air when the distance between the adjacent MWCNTs is below the threshold distance. The tunneling resistance depends on the distance between the adjacent CNTs. Under tensile strain, due to stretching of the MWCNT film, there is an increase in the space at CNT–CNT junctions which consequently increases the tunneling resistance. Hence, different to the usual metal strain sensors, the resistance strain dependency of the MWCNTs on the eraser s ubstrate is not mainly due to geometrical changes, tunneling effect between the MWCNTs and the geometrical deformations.



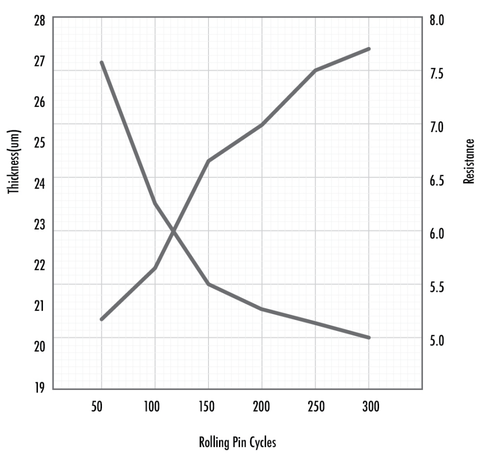
Compressive Stress



Compressive strain



Under applied tensile strain, the MWCNTs tend to form cracks which are occupied either by eraser substrate or by air. Electrons can tunnel through eraser or air when the distance between the adjacent MWCNTs is below the threshold distance. The tunneling resistance depends on the distance between the adjacent CNTs. Under tensile strain, due to stretching of the MWCNT film, there is an increase in the space at CNT–CNT junctions which consequently increases the tunneling resistance. Hence, different to the usual metal strain sensors, the resistance strain dependency of the MWCNTs on the eraser s ubstrate is not mainly due to geometrical changes, tunneling effect between the MWCNTs and the geometrical deformations.



Chapter 5

Conclusion

Conclusion

This project is a collaboration or design and technology which contributes a better understanding of technology through the use of images that the reader could visualize and relate too.

This type of collaboration is essential for more creative and understanding the new technology. I realize during project how this technical terms can be told in a simple way and science turns more interesting when it collides with design.

The illustration used here in paper deals with more logic and technical terms having aesthetic essence. These illustrations communicate the technical terms which can help a researcher to convey the idea of project more effectively.

The knowledge gained from this study deepen my understanding of the way the visuals works from meaning perspective.

The key factor of successful design is a good exploration, and the exploration start with the analysis of the content

I personally feel that there should be more collaboration of another department with the design which will make the understanding of content in a simple way.

BIBLIOGRAPHY

Carter, R., Day, B., and Meggs, Philip B. Typographic Design: Form and Communication,Fourth Edition, John Wiley & Sons, 2007.

DiMarco, John. Digital Design For Print and Web: An Introduction to Theory, Principles, and Techniques. 2010.

Eiseman, Leatrice. Pantone Guide to Communicating with Color. Pantone, Inc., Grafix Press, 2000.

Lynch, M. & S. Y. Edgerton Jr. (1988). 'Aesthetic and digital image processing representational craft in contemporary astronomy', in G. Fyfe & J. Law (eds), Picturing Power; Visual Depictions and Social Relations (London, Routledge): 184 – 220.

Marketing, Fourth Edition, New York, 1991

Seaberg, Albin G. and Reinhold,Van Nostrand. Menu Design: Merchandising and

Pastor Chuck calvarychapel.com/pastorchuck/c2k/mark-4-5

Pauwels, L. (2006). A theoretical framework for assessing visual representational practices in knowledge building and science communications. In L Pauwels (Ed.), Visual cultures of science: rethinking representational practices in knowledge building and science communication (pp. 1–25). Lebanon, NH: Darthmouth College Press.

Richards, A. (2003). Argument and authority in the visual representations of science. Technical Communication Quarterly, 12(2), 183–206. doi: 10.1207/s15427625tcq1202_3

Eraser-based strain and pressure sensors https://doi.org/10.1088/1361-6528/aa5845